Report on

Misconduct by Subra Suresh

President and CEO of Nanyang Technological University

Alternative title

Fleecing Singapore with Careers of Corruption

Subra Suresh with Nanyang Technological University

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By
Mohamed Helmy
MD, PhD

helmy.m@protonmail.com
+65 83 555 817
10 Jurong Lake Link, #15-39
Singapore 648131

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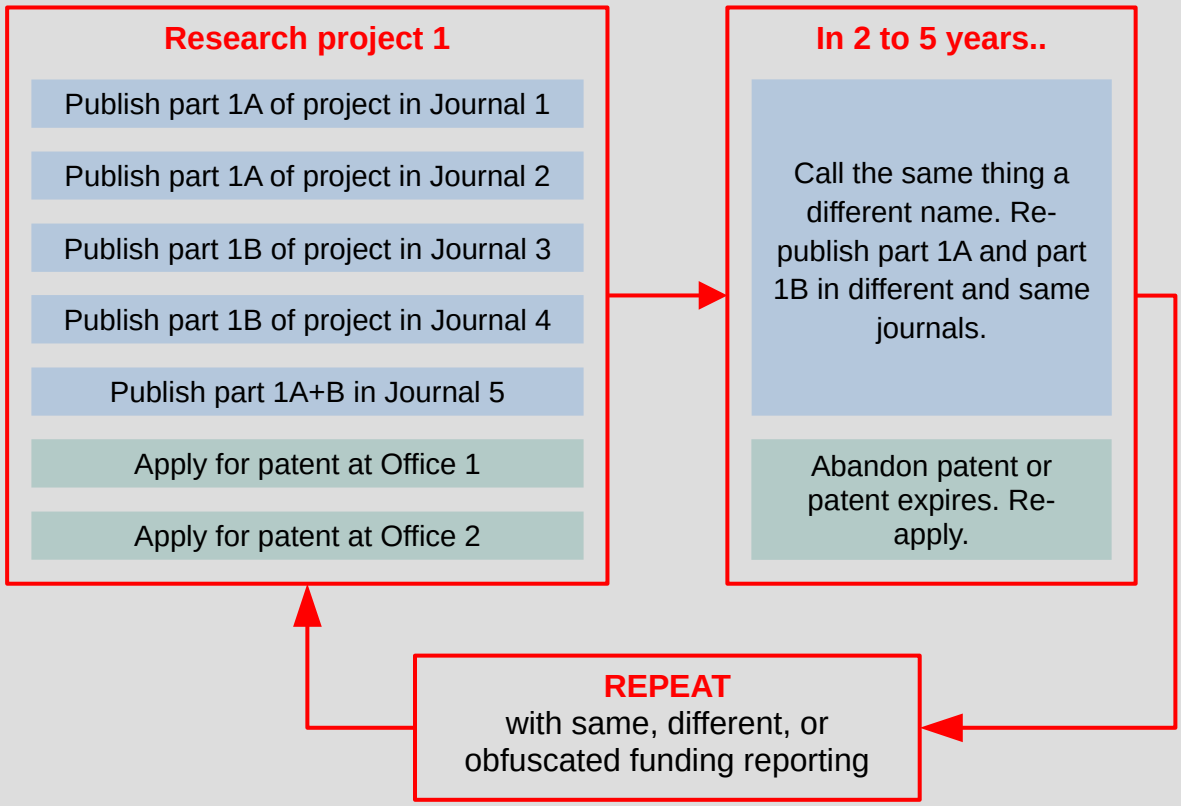
ABSTRACT

SUBRA SURESH, CAREER

THESIS DATA ACQUIRED

Doctor of science data from student Helen Conley

ARTICLE AND PATENT DUPLICATION CYCLE



RESEARCH MANAGEMENT AND GLOBALIZATION

Obfuscated merit and peer review of grant funding;

Research integrity is the scientific record *only*, not work;

Government funds basic research;

Decision-makers on funding unknown.

PLAGIARISM FOR STUDENT THESES

1. SYNOPSIS

- Suresh is currently President and CEO of Nanyang Technological University. Previous positions held by Suresh are described elsewhere (*Suresh profile pages 2021)*, and include leadership positions at Massachusetts Institute of Technology, National Science Foundation, and Carnegie Mellon University.
- Suresh started his career by taking data from students at the lab he was at, mostly from Helen Conley, and packaging these data with irrelevant text as his thesis, a doctor of science. He then published and republished this same material found in his thesis it appears as if novel and as if his own. Indeed, it appears novelty of the data and underlyi**n**g mechanisms were falsely claimed, inflated, emphasized, and repeated but with different mechanisms for the same phenomenon, by Suresh.
- Articles on which Suresh is co-author: (i) appear duplicated multiple times; (ii) appear to claim novelty where no novelty exists; and (iii) appear inconsistent and nontransparent in ethics reporting.
- Generous funding is awarded to projects in articles by Suresh and others, but the outcome of funding appears meager, in addition to appearing duplicated.
- Suresh's contribution to research management and globalization appears to consist of: (i) thoroughly obfuscating merit review of grant research proposals and peer review of the same or scientific publications; (ii) constraining integrity to the scientific record only. In other words, scientific integrity should apply to publications only and not to any other process such as research work; (iii) suggesting that resources and data should be shared openly and at the same time placed behind barriers of a financial nature; and (iv) placing the responsibility for funding basic research on government, in other words taxpayers, while at the same time placing the decision on whom and what to fund with undefined bodies.
- Suresh with others appear to apply for patents to various patent offices only to abandon the same or allow the patent to expire. The same or similar patent is then apparently applied for anew at a later date, and so on.
- Students supervised by Suresh appear to have plagiarized theses.
- Suresh said, "…"We cannot sacrifice the future by responding only to the present…".[1] Perhaps he meant to say, 'We can sacrifice the future by repeating the past.'

[1] https://www.nsf.gov/about/history/bios/ssuresh.jsp

2. SURESH'S THESIS

2.1. Summary of analysis of Suresh's thesis

- It appears Suresh took data from students at the lab he was working at and published it as if his own. He put forward 'novel' and irrelevant mechanisms to explain these data, which had already been explained accurately by the students from whom the data was taken.
- Suresh claimed in his thesis to have collected novel data on crack behavior of steels using cyclic testing under various environmental conditions, namely dry and moist hydrogen gas. Suresh also claimed to have elucidated and described novel mechanisms underlying these data. Novel data in Suresh's thesis can be mostly attributed to *re-measuring* of crack behavior of samples using cyclic testing in dry and moist hydrogen gas by Helen Conley *initially* done by (unknown) others at the Ritchie Lab. This was necessary because the initial measurements were done too rapidly, and later done accurately by Conley. Conley published these data in her thesis. Other putatively novel data in Suresh's thesis was earlier collected and published by Zamiski, and perhaps by Moss, White, and Toplosky.
- Data found only in Suresh's thesis and not previously published elsewhere appears irreproducible or irrelevant.
- Suresh presents two mechanisms as if relevant or novel to explain data in obfuscated manner. One mechanism (hydrogen embrittlement) was later abandoned by Suresh as a putative mechanism contributing to the observed phenomenon. The other mechanism (oxide-induced crack closure) was well-known and described at the time of publication.

2.2. Background and material analyzed

- Analyses discussed in this section are based on Table 1., which lists significant findings from Suresh's and others' theses as well as a lab report.
- Suresh's Doctor of Science (ScD) was supervised by Robert O. Ritchie at Massachusetts Institute of Technology (*Suresh 1981*). Also supervised by Ritchie during that period of time is a bachelor degree thesis by Helen T. Conley (*Conley 1980*), a Master's degree thesis by Gerald Frank Zamiski (*Zamiski 1980*), and a philosophy doctorate thesis (PhD) by Rosendo Fuquen-Molano (*Fuquen-Molano 1982*).

2.3. Findings at the Ritchie Lab

- Twelve conclusions are listed in Suresh's thesis, see points #2 to #13 in Table 1. Also, a plethora of what may appear to be data is mentioned in the thesis, some of which cannot be linked or else is poorly linked to the putative project, for example, see point #13 in Table 1. An analysis of Suresh's text shows that there are two main findings: (i) when testing crack behavior in a metal under hydrogen, testing variables, notably how fast the metal is 'stressed', are critical; and (ii) when there is water in the environment (*e.g.* moist hydrogen gas as opposed to dry hydrogen gas), the cracks tend to 'close', probably because a layer of oxide is formed on the crack, thus mitigating damage somewhat. These two findings are reported more comprehensively in a lab report produced for the US Department of Energy, *Ritchie et al. 1980b*, co-authored by Suresh. The work in the report was meant to address "…The influence of gaseous environment is examined on fatigue crack propagation behavior in steels…" (*Ritchie et al. 1980b*).

- These two findings are also discussed more succinctly in the article *Toplosky and Ritchie 1981* and see also *Suresh et al. 1983*). Yet another publication analogous to the report produced for the US Department of Energy and Suresh's thesis is *Suresh and Ritchie 1981*, which also appears identical to the article *Suresh and Ritchie 1982*.[2]
- The finding regarding testing crack behavior in hydrogen gas is described succintly and accurately in the bachelor thesis by Helen T. Conley (*Conley 1980*). The validity and accuracy of Conley's report is evident in an the article *Cotterill and King 1991*; though Cotterill and King (1991) refer to *Ritchie et al. 1980c*, text in the article (*Cotterill and King 1991*) is more supportive of Conley's description of the finding as opposed to Ritchie's.
- Briefly, two methods for testing crack behavior under various environmental conditions can be used, see point see points #16 and #17 in Table 1. for explanatory text from Conley's thesis. In one method, which will be referred to here as *static*, the sample is placed under a constant load in the environment in question (dry hydrogen, moist hydrogen, dry helium, room air, so on). The static method produces an outcome which is a standard, called K_{ISCC}. In the second method, *cyclic*, the sample is placed under repeated loads in the environment in question. The problem of the static method is that it is time consuming; because the result varies as a function of time, a test may require about 1000 hours to improve reliability. The cyclic method speeds up the testing process, and a model is used to estimate or predict what *would have been the result* if the sample *had been tested* with the static method. In other words, the outcome of the cyclic method of testing, *accelerated* K_{ISCC}, does not necessarily match up with the K_{ISCC}. Obviously, the testing method used should align with the purpose the metal being tested will used for: for example, if the metal will be under relatively static loads or whether it will be part of a moving system such as a motor.
- Conley is able to predict, based on references she cites, that to produce a reliable and accurate result with the cyclic testing method, the sample in question (300M steel) should be tested *slowly*, see point #18. The value Conley wished to use was 0.1 MPa√m/min. For unknown reasons, measurements for calculations were reported using a much *faster* rate of testing, 1.1 MPa√m/min.
- Despite the fact the Conley already knew that a fast cyclic testing method would produce an unreliable result (see point #18), Conley, for unreported reasons, used a testing rate one order of magnitude higher than what would have been a "…better approximation…". It is therefore consistent that in the Conclusions of the thesis, Conley reports that the outcome of the test was overestimated (see point #15). As a recommendation, Conley suggests using a slower testing rate, as she had already known and did not apply for unknown reasons.
- That static and cyclic testing methods were likely to produce varying outcomes, thus requiring careful attention to testing variables, was apparently known to Ritchie, see point #36. Puzzlingly, the rate reported by Ritchie in the report for sample testing (including 300M steel) was 0.1 MPa√m/sec, see point #34. This may not be the same rate as what Conley had *initially* wanted to use, 0.1 MPa√m/min, because the time unit is different: Conley uses minutes, and Ritchie reports using seconds. In the report, Ritchie goes on to say "…We are currently repeating these measurements using an order of magnitude slower displacement rates…", see point #34, Table 1.
- Conley predicted the discrepancy measured in crack behavior using fast and slow testing of the sample. Conley also empirically elucidated a potential cause of this discrepancy, see page 22 of *Conley 1980*. Mechanisms underlying the different outcomes of testing samples using static and cyclic methods are clearly and thoroughly discussed in the Master's thesis supervised by Ritchie, *Zamiski 1980*, see point #24. Three references are cited by Zamiski to support the argument. Two of these references are directly relevant and precise, *Cooke and Beevers 1973* and *Masounaye and*

[2] In this publication, it is stated that "…Dr. Suresh…and Dr. Ritchie…are with…University of California, Berkley. Both authors were formerly with Massachusetts Institute of Technology…" (*Suresh and Ritchie 1981*).

Bailon 1975. The third reference is to an article co-authored by Ritchie (*Aronson and Ritchie 1979*), but it has no relevance to mechanisms potentially underlying differences in crack behavior during static and cyclic testing. This is not the only puzzling reference cited by Zamiski in the thesis, as will be further discussed below. Zamiski concludes this section by citing the work originally describing putative mechanisms underlying testing methods, *Elber 1971* see point #24, Table 1.

- It was necessary for Zamiski to discuss the effect of *testing* on crack behavior because the work in Zamiski's thesis (*Zamiski 1980*) is on mechanisms underlying crack behavior and is the second finding in Suresh's thesis as well as the lab report from the Ritchie lab (*Ritchie et al. 1980b*). This finding is that cracks propagate more aggressively when the steel sample is in moist hydrogen rather than dry hydrogen. Zamiski cites four references for what is termed in the thesis 'oxide induced crack closure' as follows (see point #25 in Table xx.): (i) one reference is to Ritchie's lab report (*Ritchie et al. 1980b*); (ii) one reference is to a book chapter, *Suresh et al. 1982*, which is analogous to the article *Suresh et al. 1981*. Note that Zamiski cites the book chapter as published in 1980 – the related symposium may have been held in 1980, the correct citation for the chapter is 1982; (iii) one reference is to an article co-authored by Ritchie, *Ritchie et al. 1980c*. In addition to Ritchie, the authors listed on the article are Suresh and Moss, though the ordering of the authors is different on the article compared to Zamiski's reference. Moss also and apparently contributed to the work, and attained a thesis, but I cannot find the thesis Zamiski cites anywhere; however see *Fuquen-Molano 1982*, a doctoral thesis supervised by Ritchie in Table 1. and further discussed below. Other than as a citation in Zamiski's thesis, there is no record of the thesis by Moss, see point #23, Table 1.; (iv) one reference is to the article *Stewart 1980*. In this article, Stewart appears critical of Ritchie's hypotheses on mechanisms underlying crack closure in different materials and environmental conditions. Stewart cites *Paris et al. 1972* for data on how "…The presence of such a layer of oxide particles in the crack will also increase the load in the fatigue cycle at which crack closure occurs…", what is referred to by Zamiski as 'oxide induced crack closure'. Stewart also gives an equation to solve the magnitude of this effect under certain conditions, and discusses relevant implications. In other words, it would appear that Zamiski refers to much published material by Ritchie and Suresh, which is not useful nor relevant when compared to calculations presented by others in a publication.

2.4. Data and findings claimed by Suresh's thesis

- As mentioned above, pertinent findings in Suresh's thesis are that: (i) when testing crack behavior in a metal under hydrogen, testing variables, notably how fast the metal is 'stressed', are critical; and (ii) when there is water in the environment, moist hydrogen gas as opposed to dry hydrogen gas, the cracks tend to close, probably because a layer of oxide is formed on the crack, thus 'closing' the crack somewhat
- Data on crack behavior during cyclic testing is reported by *Conley 1980*. The finding is that cyclic testing may produce unreliable data if (in simplified terms) the test is done quickly. Data in Suresh's thesis may differ from that in Conley's in that a different kind of steel is also tested: Zamiski states that that work was done by Moss, but I could not find Moss' thesis (*Moss 1980(?)* and see *Fuquen-Molano 1982*).
- Mechanisms underlying crack behavior in dry *vs.* moist hydrogen, as well as mechanisms underlying differences in outcome of cyclic *vs.* static testing are discussed in *Zamiski 1980*. Zamiski shows that mechanisms underlying both outcome variability due to different cyclic testing variables (namely and in simple terms, how quickly the test is done), as well as 'oxide-induced crack closure', were elaborated in the literature. Data supporting oxide-induced crack closure is measured by Zamiski. To investigate crack behavior, Zamiski uses fractography. Zamiski is careful to mention that "…Such

models are shown to be at least *qualitatively* consistent with experimental observations…" (emphasis added), see points #20 and #22, Table 1.

- Other data in Suresh's thesis supporting the so-called oxide-induced crack closure model are Auger measurements, which Zamiski informs us were collected by White and a reference is made to *White 1980*. But as with Moss' thesis, there is no trace of the thesis by White; Auger data is further discussed below.
- Suresh repeats in his thesis, in the Abstract, Scope, and Conclusions, that "…Mechanisms for the influence of hydrogen in these two regimes are entirely different…", see point #2, Table 1. Here, Suresh is referring to one mechanism putatively underlying variable outcomes of cyclic testing, and another mechanism underlying so-called oxide-induced crack closure. Both mechanisms were known (see above and *Stewart 1980*), and the data were collected by others, namely Conley, Zamiski, and according to Zamiski, Moss, and perhaps White. But Suresh emphasizes the 'novelty' of oxide-induced crack closure, for example, "…A new approach termed "oxide-induced crack closure" has been developed to explain the role of environment near threshold and is shown to be consistent with experimental observations in a low strength pressure vessel steel…" (*Suresh 1981*, page 7 and again page 49) when there was no novelty at the time of publication.
- It is not clear why Suresh chose to conflate mechanisms underlying crack behavior under controlled testing variables (such as speed of stressing a sample) with those underlying a variable being tested for (such as the presence or absence of water in the gas surrounding the sample being tested). Suresh writes: "…Although it has been speculated for a number of years that corrosion deposits on crack faces might play some role determining the rates of crack growth, no quantitative analysis has yet been carried out to substantiate the exact nature of this influence…In light of the above discussions, it is clear that with the limited extent of information available in the literature, it is not possibe to make any viable mechanistic interpretations for environmental influences at threshold stress intensity levels and that no model, proposed thus far, is capable of providing possible explanations for the experimental observations…The purpose of this work is to establish a reliable data base for the effect of environments in the near theshold fatigue crack growth regime of low strength steels and to develop a mechanism to explain the influences near threshold of not only various environments, but also such mechanical and microstructural factors such as strength, grain size, load ratio, and so forth…" (*Suresh 1981*, page 6). However:
    - No "…quantitative analysis…to substantiate the exact nature of this influence…" was done, or not done rather, by Suresh. Data presented is by Zamiski. Suresh *does* present an extremely complicated and inaccessible *mathematical theoretical model* of "…this influence…"; I do not know if Suresh's model has replaced real-world testing. Furthermore, work by colleagues at MIT had already shown that "…Suggestions for further work…[include] *oxide film thickness*…[to] Study the effects of texture on the fatigue and corrosion fatigue behavior of austenitic-ferritic stainless steels…" (emphasis added, *Moskovitz 1977*, page 144). Hence, Zamiski's honest and sensical statement on the *qualitative* nature of data collected supporting the oxide-induced crack closure mechanism described, point #20, Table 1.;
    - It is not clear why Suresh thought there was "…limited extent of information available in the literature…": precise and comprehensive literature were cited and discussed by Conley and Zamiski in their theses, and which were published before Suresh's thesis;
    - Does "…establish[ing] a reliable data base…" or testing many samples constitute novelty sufficient for a Doctor of Science at MIT? Even when the data was not apparently collected by the candidate?
    - Obviously, 'load ratio' is a controlled parameter, critical to the outcome of a test, of course, as shown by Elber (1971), but nevertheless, as Conley stated, "…depend[ant] on the

patience of the experimenter…" (see point #16). In other words, load ratio does not belong with "…strength, grain size…and so forth…" as suggested by Suresh.

- Findings in Suresh's thesis converge to a large degree with those in another thesis supervised by Ritchie, *Fuquen-Molano 1982*, see points #26 to #32 in Table 1. This thesis has a title which seems congruent with the thesis by Moss, cited by Zamiski, and which I cannot find. It appears differences between data collected by Conley and Suresh on crack behavior with different cyclic testing parameters *due to a difference in the sample tested* is in *Fuquen-Molano 1982*, if not in *Moss 1980(?)*. The notable difference between Fuquen-Molano and Suresh is in discussing mechanisms: Fuquen-Molano explicitly refers to 'plastic strain', described by Elber (1971), predicted prior to sample testing by Conley (1980), discussed in Stewart (1980) and summarized by Zamiski (1980). Suresh does refer to 'plasticity crack closure' in his thesis, though he does rather dismissively and in the context of 'oxide crack closure'; obviously 'plasticity crack closure' should have been discussed in the context of testing method (static *vs.* cyclical) and testing parameters. In 1981 Ritchie was still reporting that, for the sample tested by Conley (300M), the measurements obtained from cyclic testing in dry and moist hydrogen was "…rationalized in terms of hydrogen embrittlement and oxide-induced crack closure mechanisms…" (*Toplosky and Ritchie 1981*; see also *Suresh et al. 1983*).[3] Perhaps Ritchie had reconsidered plasticity as a putative mechanism by 1982, when Fuquen-Molano's thesis was published. Note that all these implications were addressed, quite comprehensively, by Zamiski in his thesis (1980).
- In the article by Toplosky and Ritchie (1981), it is emphasized that this environmental condition (dry and moist hydrogen gas) is associated with crack behavior and mechanisms *specific* to higher strength steels such as 300M, and which are "…significantly different to behavior reported for lower strength steels…" – but these findings and mechanisms are exactly what is reported by Suresh in his thesis for lower strength steels. In any case, Suresh later abandoned 'hydrogen embrittlement', as a mechanism putatively underlying observed crack behavior in cyclic testing. In fact, it appears Suresh suggests in a manuscript he published soon after his thesis, *Suresh 1982*, that the underlying mechanism is *also* oxide-induced – which cannot be the case, of course, since oxidation of the sample in dry hydrogen gas is negligible.[4]
- Suresh claimed in his thesis that that "…oxidation depth composition profiles were obtained as a function of Auger sputtering time…" (*Suresh 1981*, page 20). However, "…Because of the difficulties associated with the calibration of sputter rate by preparing a known thickness of iron oxide, a tantalum oxide standard was used for calibration. Since there is no currently-available standard procedure, the time taken…was arbitrarily defined as the sputter time. Also, from the sputter rates

[3] Conley is not mentioned in the Acknowledgments of *Toplosky and Ritchie 1981*. Conley is not a co-author on the conference proceeding *Suresh et al. 1983*.

[4] *Suresh 1982* is a manuscript which was "…Submitted to Scripta Metallurgica…", I do not know if it was published. In *Suresh 1982*, it is boldly stated that "…A new mechanism for fatigue crack growth retardation following an overload is presented in this paper, based on a micro-roughness model. It is reasoned, with the aid of extensive experimental evidence available in the literature, that retardation following an overload is governed by the micromechanisms of near-threshold crack growth. This model is found to rationalize a number of hitherto unexplained experimental observations. Moreover, the present arguments, which suggest that plasticity-induced crack closure is not likely to be the primary mechanism for retardation following single overloads, do not exclude the role of residual stresses or blunting, but provide further mechanistic basis to account for the inconsistencies in the previous models. Additional sources of prolonged retardation, in terms of crack closure due to corrosion debris formed in moist environments, are suggested. It is pointed out that such environmental effects could play an important role in post-overload crack growth in certain alloy systems…". Data from experiments on both aluminium and steel alloys are discussed in a confused manner in the manuscript, which is not helpful because oxidized iron and oxidized aluminium behave very differently. It is not clear why Suresh chose to inform us that "…plasticity-induced crack closure is not likely to be the primary mechanism for retardation following single overloads…". To the best of my knowledge, no author suggested that plasticity-induced crack closure would play a role during static testing; the hypothesis was introduced by Elber to explain phenomena observed during cyclic testing.

calibrated with the tantalum oxide standard using this procedure, the corresponding rates for iron oxide were estimated using the data on argon ion sputtering yields (atom/ion) from Veeco Brochure V60 and Physical Electronics…Using…ion and electron beam sizes of roughly 200 and 20 μm…sputter times were obtained for several fracture surfaces. The sputter time multiplied by the modified sputter rate provides an estimate of the extent of oxidation…" (*ibid*, pages 121 and 123). In other words, Auger data in Suresh's thesis is at best not reproducible, at worst meaningless.

- Zamiski refers to a thesis by Moss (crack behavior in cyclic testing of certain steels under hydrogen) and a thesis by White (Auger data), but I could not find these theses. In *Fuquen-Molano 1982*, 'recent Auger measurements of oxide film thickness' are mentioned twice, and two references are cited: one is Suresh's thesis (*Suresh 1981*) and the other is the book chapter *Suresh et al. 1982* (analogous to the article *Suresh et al. 1981*); no mention of White is made. The only connection to White (mentioned by Zamiski) I could find is a meeting abstract (*Suresh et al. 1980*) on which White is co-author, and which carries a title similar to *Suresh et al. 1981*.

2.5. Work acknowledgement

- As discussed above, data in Suresh's thesis was collected by Conley and Zamiski, and perhaps White and Moss. In his thesis, Suresh does refer to Zamiski's thesis and the article co-athored by Zamiski (*Suresh et al. 1981*), and Moss' thesis (which cannot be found) and the article co-authored by Moss (*Ritchie et al. 1980a*); no reference nor acknowledgement of Conley nor White is made by Suresh.
- Data collected by Conley is central to the report submitted by the Ritchie lab to the US Department of Energy (*Ritchie et al. 1980b*). Indeed, Conley's lucid bachelor thesis and the data Conley collected and analyzed form the basis of the report, see points #33 to #37 in Table 1. However, the report states that there was "…assistance from graduate students S. Suresh and J. Toplosky, and undergraduate Helen Conley…", see point #39 Table 1.[5] In the report, it was 'expected' that Topolsky would have produced a thesis in the same year the report was published, see point #38. As with Moss and White, I could not find Toplosky's thesis.[6] It is not clear why Conley's contribution was not acknowledged with co-authorship in the report. Also, any contribution by Toplosky was later disacknowledged: the authors on a report analogous to the one submitted to the US Department of Energy and published later are only Suresh and Ritchie (*Suresh and Ritchie 1981*), and Conley is not a co-author on the article showing these data, *Toplosky and Ritchie 1981*; and see also *Suresh et al. 1983*. It is important to note that, from Conley's thesis, Conley would not have agreed with the mechanisms suggested in *Toplosky and Ritchie 1981* to explain the data.
- The report by Ritchie, Suresh, and Toplosky acknowledges that *cyclic testing of the samples of interest had been done* ***rapidly,*** see point #34 Table 1. The report also states that the test was being ***presently*** (1980) repeated and a very odd reference is cited: what appears to be a conference proceeding from *1974*, see point #37 Table 1. In other words, Conley's contribution was actively dis-acknowledged in preference to a conference proceeding from 1974 which was somehow contributing to data 'presently' collected in 1980. Here it is important to recall Conley's *prediction* that rapid testing would produce unreliable results *before* testing was done, and that, for unknown reasons, pre-test calculations for *rapid* testing were anyways made.
- In Conley's thesis, the 'Conclusions and recommendations' are about a page in length, typed out with generous spacing, quoted in point #15 Table 1. As mentioned above, Conley is succinct and accurate in her thesis, almost abrupt. Conley nevertheless managed to mention "…300-M [ultrahigh-strength steel] tempered for 1 hr. at 300°C…" three times in that short page, a vital sample in Ritchie's report to US Department of Energy. It is therefore confusing that Zamiski should write: "…Test conducted

[5] In the article *Ritchie et al. 1980a*, it is stated that Suresh and Moss are Graduate Research Assistants.

[6] John Toplosky is thanked by Conley in her thesis for help and guidance.

on the 320^{0}C temper condition produced questionable results, possibly due to residual stresses present. Therefore the 320^{0}C temper results and problems are described in Appendix B…", see point #23 Table 1. It is those very same type of 'questionable results' which produced Ritchie's report to the US Department of Energy, as well as a significant proportion of Suresh's thesis.

3. DUPLICATION OF THE SCIENTIFIC RECORD BY SURESH

3.1. ACOUSTIC SEPARATION OF CELLS

- The articles *Li et al. 2015*, *Wu et al. 2018* and *Ding et al. 2014* describe an acoustic device to separate cancer cells from blood without damaging them.[7]
- As seen from Table 2. (see also Table 3. #1, #2, and #3), the article *Wu et al. 2018* is apparently obviously plagiarized from *Li et al. 2015* with some content also from *Ding et al. 2014*. The only difference between *Wu et al. 2018* and *Li et al. 2015* worth mentioning is that in some experiments the former uses cells from prostate cancer patients, the latter breast cancer patients.
- Other publications by Suresh and others putatively presenting analogous work include *Guo et al. 2016*, *Wu et al. 2017*. See also *Suresh 2007a*. Other articles by co-authors of Suresh published without his co-authorship to consider in this regard include *Ding et al. 2012* and *Ding et al. 2013*.

3.2. MALARIA: Humanized mouse model

- In the article *Chen et al. 2014* (Table 3. #4), it is shown that depleting natural killer cells of humanized mice, referred to in the article as "…RBC-supplemented, immune cell-optimized humanized (RICH) mice…", increases malarial parasitemia in those mice. The articles *Chen et al. 2009* and *Chen et al. 2013* are referred to. *Chen et al. 2009* contributes to the model through injection of plasmids encoding human cytokines injected into tail vein of mice. The humanized mouse model in *Chen et al. 2014* is critically based on work from *Chen et al. 2013*, in which human cells extracted from human fetal liver are injected intrahepatic and/or intracardiac in mice.
- In the article *Amaladoss et al. 2015* (Table 3. #5), the model used in *Chen et al. 2014* is presented. It is unclear if there is any novelty. Puzzlingly, both *Chen et al. 2014* and *Chen et al. 2009* are referred to in *Amaladoss et al. 2015*, but not *Chen et al. 2013*, which is critical to the model. Also puzzlingly, though all mice used in these four more-or-less analogous works were apparently 'humanized' in the same way, only the mice in *Chen et al. 2014* are 'RICH'.
- In *Chen et al. 2014*, human fetal liver cells were injected intracardiac in mice and, to the best of my knowledge, without IRB approval.
- It appears that no human fetal liver was used in *Amaladoss et al. 2015*, though it is recommended in *Chen et al. 2013* and used in *Chen et al. 2014*. IRB and IACUC approvals were obtained in *Amaladoss et al. 2015*.
- It is not clear if approval was obtained for *Chen et al. 2013*; the study was done "…in accordance with the institutional ethical guidelines of the National University Hospital of Singapore…", and yet it is the only study mentioned in this context in which it is reported that "…All women gave written informed consent for the donation of their fetal tissue for research…".

[7] Regarding articles published by Suresh and others analyzed in this report, I found only twenty (20) publications on Suresh's Google Scholar verified webpage (*Suresh_GoogleScholar 2021*). The publications authored or co-authored by Suresh and discussed here (far in excess of 20) were collated by manual search through hits on Google Scholar using various search terms, institute webpages, and from references in articles published by Suresh and others.

3.3. MALARIA: Anti-malarial agents

- The article *Chandramohanadas et al. 2014* (Table 3. #6) claims "…the discovery of a small molecule inhibitor, NIC…". This is incorrect, the compound was characterized by others and earlier, see *Basappa et al. 2012* and *Basappa et al. 2014*. Indeed, elsewhere in *Chandramohanadas et al. 2014*, it is stated that "…it was earlier demonstrated that NIC binds to vascular endothelial growth factor (VEGF) resulting in reduced cancer cell proliferation [*Basappa et al. 2012*]…". See also *Gaonkar et al. 2009*.
- The article *Chandramohanadas et al. 2011* (Table 3. #7) claims to "…provide a comprehensive, previously unavailable body of information on the combined effects of biochemical and biophysical factors on parasite egress from iRBCs…" as shown by "…dramatic re-distribution of three-dimensional refractive index (3D-RI) within the iRBC…". This is puzzling because it was earlier claimed by Suresh and others in *Park et al. 2008* that they "…presented systematic measurements of nanoscale fluctuations associated with RBCs parasitized at all stages by *P. falciparum* at physiological and febrile temperatures. Our approach to studying *Pf*-RBCs uniquely combines optical interferometry, biophysics, and cell nanomechanics…". iRBCs and *Pf*-RBCs both denote red blood cells infected with malaria. In other words, the terms are synonymous.
- The article *Chandramohanadas et al. 2011* uses the compound E64d (see for example *Hara et al. 1988*, *Patel et al. 1989*). Similar data was reported earlier without co-authorship by Suresh in *Chandramohanadas et al. 2009*, and in which it is stated that "…DCG04 (a biotinylated derivative of the nonspecific papain family protease inhibitor E64)…" was used. In other words, "…DCG-04 targets cysteine proteases inhibited by E-64…" (*Greenbaum et al. 2000*); see also *Kašný et al. 2007*, a reference for more information on the compound group.

3.4. MALARIA: Infected red blood cells biophysics

- The articles *Fedosov et al. 2011a* (Table 3. #9) and *Fedosov et al. 2011b* (Table 3. #8) describe mathematical models of red blood cell behavior when infected with malaria. Both models arrive at the conclusion that the model(s) presented is in "…excellent agreement with optical tweezers experiments…" (*Fedosov et al. 2011a* and *Fedosov et al. 2011b*). Nevertheless, perhaps these models were deemed inadequate by also Suresh but different co-authors because later *Zhang et al. 2015* (Table 3. #10) was published, and which finds that model prediction "…falls within the range of existing experimental data [*Mills et al. 2004*]…", *Mills et al. 2004* being an article by Suresh and others showing optical tweezers experiments. This is also very puzzling because in an article previous to *Zhang et al. 2015* (Table 3. #10) by Suresh and others, *Bow et al. 2011* (Table 3. #14), it was already stated that "…optical tweezers…" is one of several "…methods [which] are labor-intensive, expensive, and time-consuming. *Furthermore, the relevance of these essentially static mechanical responses to what the RBC experiences in the circulation of a living organism may be limited*…" (emphasis added, *Bow et al. 2011*).
- A or the model or models of infected red blood cells is/are also presented in other publications by Suresh and others including *Mills et al. 2007*, *Aingaran et al. 2012*, *Du et al. 2013*
- It is unclear if the models mentioned above published between 2007 and 2013 were useful, because of the model(s) published in 2015, and because of the limitation of the data used as stated in the article published in 2011.

3.5. MALARIA: Behavior of infected red blood cells

- The article produced by Suresh and others, *Carvalho et al. 2013* (Table 3. #15) concludes that the "…binding force of the CSA–*Pf*EMP1 complex decreases significantly with exposure to febrile temperature…". CSA–*Pf*EMP1 is malaria parasite erythrocyte membrane protein 1 (*Pf*EMP1), and "…human host receptors, such as chondroitin sulfate A…" (CSA). In other words, contact surface between the parasite and blood vessels.
- Suresh is not a co-author on *Xu et al. 2013*, an article apparently analogous to *Carvalho et al. 2013* except in the Conclusion produced in text. The only co-author shared between these two articles is Ming Dao. Ming Dao is corresponding author on *Carvalho et al. 2013* whereas the corresponding author on *Xu et al. 2013* is Chwee Teck Lim, implicated in misconduct elsewhere.[8] Neither article refers to the other.
- In *Xu et al. 2013*, experiments "…identify the main factor responsible for the decrease of adhesion strength – the rupture area size, which determines how many adhesion bonds share the rupture load generated by shear flow…". This is puzzling since the same or similar methods were used in *Xu et al. 2013* and *Carvalho et al. 2013*, and the institutes overlap, but these mathematical models and high-tech measurements produced completely different mechanisms for cytoadherence of malaria parasites coming into contact with blood vessels.
- Though it appears that Chwee Teck Lim disagreed with the findings in *Carvalho et al. 2013*, and Ming Dao ambivalently agreed or disagreed with findings in both *Carvalho et al. 2013* and *Xu et al. 2013*, the situation is apparently further and recently complicated. This is because of the publication of analogous articles *Lim et al. 2017*, *Zhang et al. 2018* and *Lim et al. 2020* (Suresh is not a co-author on these three articles, Ming Dao is and Chwee Teck Lim is a co-corresponding author on *Lim et al. 2017*, *Zhang et al. 2018*, *Lim et al. 2020*). In *Lim et al. 2017*, *Zhang et al. 2018* and *Lim et al. 2020*, the findings of *Carvalho et al. 2013* regarding temperature dependence of malarial cytoadherence are confirmed and those of *Xu et al. 2013* are disregarded. See also *Zhang et al. 2018*.
- Perhaps the disparate findings in this section are reconciled in a thesis supervised by Suresh, where it states that "…Initial results on RBCs infected with *Plasmodium falciparum* malaria suggest that the parasite and its related exported proteins act to increase the effective viscosity of the RBC membrane. The role of the temperature-dependent, viscous behavior of the RBC membrane is further explored in microfluidic flow experiments, where the flow behavior of RBCs is quantified in fluidic structures with length scales approaching the smallest relevant dimensions of the microvasculature…" (*Quinn 2010*). See also *Quinn et al. 2011* (co-authored by Suresh).
- In addition to work co-published by Quinn and Suresh, the disparate findings in *Carvalho et al. 2013* and *Xu et al. 2013* are also partially reconciled in the article by Suresh and others, *Peng et al. 2013*, which reports in malaria-infected cells "…experiments and corresponding systematic DPD simulations probe the governing constitutive response of the cytoskeleton, elastic stiffness, viscous friction, and strength of bilayer–cytoskeletal interactions as well as membrane viscosities…". However, there are no experiments, only "…corresponding …simulations…". Ming Dao is a co-author on *Peng et al. 2013*, but Chwee Teck Lim is not. Puzzilingly, David John Quinn, the author of the thesis and work, is not a co-author on *Peng et al. 2013*.
- It is difficult to understand how Suresh published a similar finding to that mentioned above with a largely different group of authors in which it is stated that "…Although quasi-static single cell assays show reduced ring-stage *Pf*-RBCs deformability, the parameters influencing their microcirculatory behavior remain unexplored…" and yet it is concluded that "… incubation at febrile temperature

[8] See the report on misconduct by Singapore awardees of *Human Frontier Science Program* grants on www.nanyangscandal.com.

impaired traversal of [Ring-Infected Erythrocyte Surface Antigen]-expressing *Pf*-RBCs…" in *Diez-Silva et al. 2012*. Interpretation of this becomes even more difficult in light of an article published earlier by the same group including Suresh in which it is stated that "…Here, for the first time, we report rheology of the single, isolated RBC with and without P. falciparum merozoite invasion, spanning a range from room temperature to febrile conditions (41°C), over all the stages of parasite maturation…" (*Marinkovic et al. 2009*; see also *Marinkovic et al. 2006*, *Puig-de-Morales-Marinkovic et al. 2007*, and *Puig-de-Morales-Marinkovic et al. 2007* discussed below).[9]

- The emphasis of the novelty of the findings in *Marinkovic et al. 2009* is even more difficult to interpret in light of the fact that what appears to be analogous work was earlier published in *Puig-de-Morales-Marinkovic et al. 2007* by Suresh and at least two of the authors on *Marinkovic et al. 2009*. Furthermore, Suresh and co-authors published an article carrying an identical title to that in *Puig-de-Morales-Marinkovic et al. 2007* ('Viscoelasticity of the human red blood cell') in an even earlier article, *Marinkovic et al. 2006*. I am unable to access the main text of *Marinkovic et al. 2006*; however, the findings and numerical data reported in *Marinkovic et al. 2006* appear identical to that reported in *Puig-de-Morales-Marinkovic et al. 2007*.

3.6. MALARIA: Work produced without Suresh's co-authorhsip

- Other articles (including preprint) to consider directly or indirectly related to Suresh's work on malaria and published without Suresh's co-authorship include *Singh et al. 2004*, *Cunningham et al. 2005*, *Blythe et al. 2008*, *Foth et al. 2008*, *Gao et al. 2008*, *Blythe et al. 2009*, *Grüber et al. 2010a*, *Liew et al. 2010*, *Yoon et al. 2010*, *Bapat et al. 2011*, *Basak et al. 2011*, *Foth et al. 2011*, *Mok et al. 2011*, *Rovira-Graells et al. 2012*, *Witmer et al. 2012*, *Gao et al. 2013*, *Harikishore et al. 2013*, *Huang et al. 2013*, *Huang et al. 2014*, *Lee et al. 2014b*, *Lee et al. 2014a*, *Mok et al. 2014*, *Siau et al. 2014*, *Anusha et al. 2015*, *Fook Kong et al. 2015*, *Chen et al. 2016b*, *Goh et al. 2016*, *Huang et al. 2016*, *Siau et al. 2016*, *Yam et al. 2016*, *Aniweh et al. 2017*, *Martins et al. 2017*, *Singh et al. 2017*, *Ng et al. 2018*, *Subramanian et al. 2018*, *Ye et al. 2018*, *Baumgarten et al. 2019*, *Hammam et al. 2019*, *Siau et al. 2019*, *Subramanian et al. 2019*, *Thamarath et al. 2019*, *Bryant et al. 2020*, *Chew et al. 2020*, *Lim et al. 2020*, *Omelianczyk et al. 2020*, *Patra et al. 2020*, *Wang et al. 2020*, *Sheriff et al. 2021*, *Sinha et al. 2021*
- Review articles to consider include *Chen et al. 2016a*, *Yam et al. 2017*, *Yam and Preiser 2017*
- Conference presentations to consider include *Halim et al. 2006*, *Lee et al. 2006* and *Liu et al. 2018b* which appears identical to *Yuen et al. 2018* except Google Scholar authorship metadata is arranged differently.
- See also *Hu et al. 2007*, *Quinto-Su et al. 2009*, *Grüber et al. 2010b*.
- It should be noted that a majority of the publications mentioned here were co-authored by Peter R. Preiser, 'Associate Vice President (Biomedical and Life Sciences), Nanyang Technological University Professor, School of Biological Sciences'. Other notable principal investigators include Ming Dao and Chwee Teck Lim.

[9] I cannot ascertain if the first author of *Marinkovic et al. 2009* is the same as in *Puig-de-Morales-Marinkovic et al. 2007*. Interestingly, in the latter article, Suresh and others declare, "…We report here the *first measurements* of the complex modulus of the isolated red blood cell…" (emphasis added, *Puig-de-Morales-Marinkovic et al. 2007*).

3.7. MALARIA: Publicity for Suresh and others

- In 2015, a news article was published is titled 'CMU President Subra Suresh, Collaborators Discover New Mechanism Behind Malaria Progression Findings Provide a New Avenue for Research in Malaria Treatment' (*CMU news 2015)*, probably referring to the article *Zhang et al. 2015*. "…Instead, the nanoscale knobs that cause the red blood cells to stick to the vein's walls also cause the membrane to stiffen through a number of different mechanisms, including composite strengthening, strain hardening and density-dependent vertical coupling effects…According to the researchers, the discovery of this new mechanism responsible for the stiffening of infected red blood cells could provide a promising target for new antimalarial therapies…" (*CMU news 2015)*. Analogous work is discussed above.
- In 2018, news articles and social media blurbs were released to the effect that "…Scientists from NTU, SMART and MIT discover potential treatment for severe malaria…" (*Malaria discovery 1 2018*, and "…Treatment for drug-resistant malaria possible within 10 years: MIT-SMART-NTU team…" (*Malaria discovery 2 2018* and see also *Malaria discovery 3*, *4 2021)*. These probably refer to the article *Ye et al. 2018* which does not include Suresh as a co-author. In this article and to the best of my understanding, a mechanism (namely, MDA5 pathway) is described for a finding in *Chen et al. 2014* (an article including Suresh as co-author) by which natural killer cells may decrease parasitemia. This is puzzling because different mechanisms including pathways were described earlier, and later, by the same principal investigators, for natural killer cell effect on parasitemia: earlier in the article *Chen et al. 2009*, and later in the preprint *Chew et al. 2020*. The latter describes pathways apparently different from those outlined in *Ye et al. 2018* and also promises "…developing more effective vaccines by targeting parasite immune evasion…".
- The description of a mechanistic pathway seems quite removed from the discovery of a treatment. Also, it seems different pathways are emphasized at various periods of time. Also, it seems a different approach to find a treatment for malaria was publicized earlier, namely by elucidating the biophysical properties of infected red blood cells, discussed below.

3.8. RED BLOOD CELL BIOPHYSICS

- Discussing red blood cell deformability, Suresh and others state in a 2005 article titled *Spectrin-Level Modeling of the Cytoskeleton and Optical Tweezers Stretching of the Erythrocyte*, "…We have devised and implemented a liquefied network structure evolution algorithm that relaxes shear stress everywhere in the network and generates cytoskeleton structures that mimic experimental observations…" (*Li et al. 2005*).
- Mathematical models to describe red blood cell deformability and flow in inherited conditions such as sickle cell anemia with or without experimental data input published by Suresh and others include *Suresh 2006*, *Puig-de-Morales-Marinkovic et al. 2007*, *Li et al. 2008*, *Byun et al. 2012*, *Du et al. 2014*, *Fedosov et al. 2014*, *Du et al. 2015*, *Hosseini et al. 2016*, *Li et al. 2016*, *Pivkin et al. 2016*, *Li et al. 2017*, *Li et al. 2018*, *Papageorgiou et al. 2018*. Duplication between articles is not subtle. Reviews on the topic by Suresh and others include *Diez-Silva et al. 2010*.
- In *Park et al. 2010a*, Suresh and others state "…we have presented definitive evidence that membrane fluctuations in the RBC membrane have a metabolic as well as thermal energy component that are localized at the outer area of the cell. Our results suggest that the spectrin-bilayer binding, through local remodeling of the spectrin junctions, gives rise to this non-equilibrium dynamics. This remodeling is also important in determining cell deformability…". See also *Park et al. 2011*.
- In *Li et al. 2018*, Suresh and other present a mathematical model to "…suggest that in inherited RBC disorders, the spleen not only filters out pathological RBCs but also directly contributes to RBC

alterations…" and in *Qiang et al. 2019*, Suresh and others state "…We present a general microfluidics method that incorporates amplitude-modulated electrodeformation to induce static and cyclic mechanical deformation of RBCs. Fatigue of RBCs leads to significantly greater loss of membrane deformability…". Similar work including review articles was published by Suresh and others also in *Dao et al. 2003*, *Van Vliet et al. 2003*, *Mills et al. 2004*, *Dao et al. 2006*, *Li et al. 2007*, *Lykotrafitis et al. year unknown*. See also *Bao and Suresh 2003*, *Lim et al. 2004*, *Suresh 2007b*, *Grover et al. 2011*

- Analogous work by Suresh's co-authors published without his co-authorship appears to have been extensively duplicated and may include *Galpayage Dona et al. 2017*, *Liu et al. 2017a*, *Liu et al. 2017b*, *Qiang et al. 2017a*, *Qiang et al. 2017b*, *Du et al. 2018*, *Liu et al. 2018a*, *Qiang et al. 2018a*, *Qiang et al. 2018b*, *Qiang et al. 2018c*, *Du and Dao 2019*, *Du and Qiang 2019*, *Liu et al. 2019*, *Dieujuste et al. 2020*, *Liu et al. 2020*, *Qiang et al. 2020*.[10]

3.9. OTHER PUTATIVELY DUPLICATED PUBLICATIONS BY SURESH

- Metallization or elasticity of diamond: *Suresh and Li 2008*, *Banerjee et al. 2018*, *Shi et al. 2020*. See also *Shi et al. 2019*, *Shi et al. 2021*. See also *Lu et al. 2020*
- Biophysics of neurons: *Bernick et al. 2011*, *Prevost et al. 2011a*, *Prevost et al. 2011b*.

[10] The doctoral thesis by Yuhao Qiang 'Mechanical fatigue testing of human red blood cells using the electro-deformation method' (2019) at Florida Atlantic University appears to have been removed by request of the author, see http://fau.digital.flvc.org/islandora/object/fau:41960.

4. FUNDING AWARDED TO AND REPORTING BY SURESH AND CO-AUTHORS

4.1. As seen from Table 4. funding reporting in articles by Suresh and others is nontransparent.

4.2. Notably, where information is available, the outcome of a grant in terms of publications or recognizable science appears very meager.

4.3. Suresh is not mentioned as an awardee in the sample of funding analyzed, or there is no information on awardee, so this is unknown in the sample except perhaps for regarding the "…The distinguished professors will be awarded an annual research fund, and its size will depend on the nature, scope and field of their scholarly work, and reviewed every five years. Details on the potential size of this fund are not available…The distinguished professors will be awarded an annual research fund, and its size will depend on the nature, scope and field of their scholarly work, and reviewed every five years. Details on the potential size of this fund are not available…The professors will be encouraged to present lectures and supervise students or post-doctoral fellows at NTU…" on which information other than the awardee, Suresh, will not be disclosed.[11]

4.4. In addition to apparently meager outcome from very generous grants awarded in publications by Suresh and others, numerous funding from other sources contributed to that same meager outcome.

4.5. Where duplicated outcome from a project is apparently produced from a grant awarded to publications by Suresh, no information on the grant is available.

[11] https://www.straitstimes.com/singapore/education/ntu-launches-elite-professorship-scheme

5. RESEARCH MANAGEMENT AND GLOBALIZATION ACCORDING TO SURESH

5.1. Background

- Evidence discussed in this section was produced by Suresh in his capacity as a leading member of the National Science Foundation (USA) and the Global Research Council.

5.2. *Suresh 2011*: MERIT REVIEW AND/OR PEER REVIEW

- An editorial published by Suresh (2011a) in *Science* is titled 'Moving Toward Global Science'.
- The editorial speaks of "…the lure of innovation, the sway of geopolitical events, and tighter economic interdependence…Relative precollege student achievement rankings, intellectual property registrations, and authorship of scientific papers highlight a dynamic global balance…" (*Suresh 2011*).
- The purpose of the editorial is apparently to address the question: "…the world has become highly interconnected, so that local economic shifts hinge not only on long-term support for scientific research in each country but also on creative global collaboration. Cooperation in this context requires new thinking and an auspicious environment in which to cultivate and fortify this synergy. *What strategies will move us there?*…" (emphasis added, page 802, *Suresh 2011*).
- Suresh writes that "…The most fundamental barriers to bilateral and multilateral international collaborations are disparate standards for scientific merit review and differences in the infrastructures that ensure professional ethics and scientific integrity…" (*Suresh 2011*).
- The solution appears to the "…merit review principles [which] were released at the May 2012 Global Summit on Merit Review…" and are "…Expert Assessment…Transparency…Impartiality…Appropriateness…Confidentiality…Integrity and Ethical Consideration…" (*NSF Global Summit 2012)*. Please note that at the time of publication "…The terms Merit Review and Peer Review are used interchangeably…" (*NSF Statement 2012)*. The Principles were generated for the benefit of "…Research funding agencies worldwide…to assure that government funding is appropriately expended on the most worthy projects to advance the progress of science and address societal challenges…" (*NSF Statement 2012)*. These Principles were later revised (*GRC Merit Background 2018)*. In the revised statement, "…For some participants the term Merit Review is used to distinguish the wider assessment of the merits of a proposal, beyond just the 'peer review' of scientific excellence by scientific peers, such as the potential relevance to beneficiaries or potential impact of the proposal…" (*GRC Merit Revised 2018)*.
- Suresh writes "…Deliberate institutionalization of both rigorous merit review and infrastructure for ensuring scientific ethics and integrity is essential in the international arena…" and thus the "…2012 summit will develop a foundation for international scientific collaboration, elucidating acceptable merit review principles…" (*Suresh 2011*, page 802).

5.3. *Suresh 2012b*: MERIT AND/OR PEER REVIEW REVISITED, INTEGRITY OF RECORD ONLY, AND UNKNOWN DATA

- The editorial published by Suresh (2012b) in *Science* is titled 'Cultivating Global Science'.
- The editorial states that "…In our rapidly expanding global scientific research enterprise, good science anywhere is good for science everywhere, provided that there exists an open flow of information with transparent processes to promote rigorous peer review and scientific integrity…" (*Suresh 2012b*). This sentence, linking 'peer review' to 'scientific integrity' suggests that Suresh is

referring here to peer review conducted during the process of publication in scientific journals. However, this is not the case because it is later stated that "…One major barrier to successful international scientific collaboration is variation in what constitutes appropriate peer review of research proposals…", indicating that the former reference to 'peer review' is in the context of 'merit review' of grant proposals (*NSF Global Summit 2012* and *GRC Merit Revised 2018*, see above), and not the common use of the term as in peer review of submitted manuscripts with scientific journal publishers, and as an important mechanism of preserving integrity of the scientific record.

- Having overcome "…One major barrier to successful international scientific collaboration [which] is variation in what constitutes appropriate peer review of research proposals…" (*Suresh 2012b*, page 959) with the generation of the Merit Review Principles (*NSF Global Summit 2012)*, Suresh states "… Going forward, regional meetings over the next year will focus on identifying core principles of scientific integrity, seeking consensus on potential subjects such as authorship, accuracy of data, and human subjects protocols. Much work has been done on this topic, but the GRC hopes to identify principles on which there is widespread concurrence and explore compliance mechanisms. The objective will be to adopt basic principles at the 2013 Global Summit, which will be co-hosted by Germany and Brazil in Berlin. Regional meetings will also begin to address the very complex challenge of open and shared access to scientific information—both data and publications…" (*Suresh 2012b*).

- The agenda for the 2013 Global Summit appears to have been modified somewhat from the time *Suresh 2012b* was written. To the best of my knowledge, there is no mention whatsoever of "… authorship, accuracy of data, and human subjects protocols…" in outcomes of the 2013 Global Summit (*GRC Summit 2013)*, which is the 'Statement of Principles for Research Integrity' (*GRC Statement Integrity 2013)*.[12] As with the Merit Review Principles published the year prior and in line with the Global Research Council purposes, the 'Statement of Principles for Research Integrity' is directed to "…research funding agencies [which] have an obligation to ensure that the research they support is conducted in accordance with the highest standards possible…" (*GRC Statement Integrity 2013)*. It is not evident how 'authorship' and 'data accuracy' mentioned by Suresh (2012b) in his editorial were addressed by the GRC Summit of 2013.

- The Global Research Council 'Statement of Principles for Research Integrity' states that "…Within the framework of the Responsible Conduct of Research, the basic principles of Research Integrity - namely honesty, responsibility, fairness and accountability – are enshrined in foundational documents…" and these 'foundational documents' are, according to the Statement, "…For example: the Singapore Statement, the InterAcademy Council IAP Policy Report, and the European Code of Conduct for Research Integrity…" (*GRC Statement Integrity 2013)*. If "…human subjects protocols…" (*Suresh 2012b*) mentioned by Suresh in his editorial were addressed in the 2013 Global Summit, then the Helsinki Declaration is conspicuously absent from the examples of 'foundational documents' listed in the footnote in the Statement.

- Another outcome of the 2013 Global Summit was an Action Plan to promote Open Access, which is "…sharing research publications openly…" and which is comprised of "… three basic principles: encouragement, awareness rising, and support for researchers that wish to provide their results in Open Access. The implementation requires engaging a number of stakeholders: in addition to scientists and scholars themselves, for instance, universities, science organisations, libraries, and publishers…" (*GRC Summit 2013)*. There is no mention of 'data' in the 2013 GRC Summit or Meeting press release (2013), but which was emphasized by Suresh thus: "…very complex challenge of open and shared access to scientific information—both data and publications…" (*Suresh 2012b*). If by 'data' Suresh was referring to that which is associated with a publication, then, for a vast majority of researchers the challenge to freely sharing data does not appear to be complex, since sharing such

[12] Outcomes of the Global Research Council Summit of 2013 may also include the National Science Foundation International Gender Summit of 2013 (see https://www.nsf.gov/news/news_summ.jsp?cntn_id=129570).

data can be easily arranged with a publisher of a scientific article, the institute producing the data, or platforms in various fields of study for freely sharing information, computer code, *etc.* A possibility is that 'data' here refers to "…the sharing of data and best practices for high-quality collaboration among funding agencies worldwide…" (*GRC 2021*); in other words, data relevant to the work of funding agencies. However, such data is freely accessible from the Global Research Council website. Perhaps by 'data' here, Suresh meant data collected from specialized and globalized research ventures, such as at CERN and from various large telescopes, and which he terms 'big data' elsewhere; this is discussed below.

- After emphasizing the "…very complex challenge of open and shared access to scientific information —both data and publications…", the article ends with "… By harmonizing the standards that underlie different national systems, we can create the smoothly operating system of global science essential to addressing the world's most pressing challenges…" (*Suresh 2012b*). Which 'different national systems' was Suresh referring to? In what way may 'harmonization of standards underlying different national systems' resolve the issue of open access, for example?
- Does the Global Research Council not mainly and mostly address funding agencies (*GRC 2021*)? Why was this not made explicit by Suresh, neither in *Suresh 2011* nor in *Suresh 2012b*?

5.4. *Suresh 2012a*: NONTRANSPARENT SHARING OF DATA INCLUDING UNKNOWN DATA AND RESOURCES

- The article published by Suresh (2012a) in *Nature* is titled 'Global challenges need global solutions'. The article states "…Subra Suresh sets out the institutional reforms needed for collaborative action among international *research-funding agencies* to tackle the challenges humanity faces…" (emphasis added, *Suresh 2012a*).
- In the opening paragraph, Suresh writes "…The challenges confronting global decision-makers are growing in complexity, intensity and urgency. Environmental change, pandemics, natural disasters, nuclear catastrophes, displaced populations, water shortages, rising ocean levels and widespread malnutrition do not stop at national borders or the water's edge. Addressing such issues requires cross-border cooperation and pooled resources…" (*Suresh 2012a*, page 337). This is important because it implies that the changes suggested by Suresh in the article, "…**FOUR RECOMMENDATIONS**…" (emphasis in the original, *Suresh 2012a*, page 337), will work towards mitigating the destructive effect of calamities such as nuclear catastrophes and widespread malnutrition on the human condition.
- The recommendations made by Suresh addresses the problem(s): "…What are the barriers to cross-border scientific collaboration? One is the current framework for investment in research and development. Funding is governed and constrained largely by national and local policies, processes and priorities. These frequently impede cooperation among different government agencies, institutions and individuals. There are many more. For example, scientific peer review needs to be consistent across borders. Scientists need to be assured that data generated through cross-border collaborations meet certain standards of quality and research integrity, and that they will be preserved and accessible to other researchers — and the public — in the future. There are issues of intellectual-property rights, and constraints on the mobility of scientists. Removing these barriers will require pro- active principles and policies, developed and implemented collectively. To this end, I have four recommendations…." (*Suresh 2012a*).
- Here, it is not clear if 'scientific peer review' is *not* referring to the process occurring during publication of novel findings, in a journal. This would be the generally understood meaning of the term and, needless to say, it should be 'consistent across borders', 'meets standards of quality and integrity', and is what 'other researchers and the public' would wish to access most frequently. The

problem is that Suresh here further obfuscates 'merit review' (of grant proposals) and 'peer review' (of articles to be published in scientific journals). This is because he refers to 'data *generated*' and not 'data funded'. Suresh later refers to "…commitment to, coordinating efforts to improve peer review from many science-funding agencies…" (*Suresh 2012a*). In other words, Suresh is might be nevertheless referring to 'merit review' as 'peer review' in the first instance.

- The first recommendation is to "…**Standardize the principles for merit review and research integrity**…At its inaugural meeting, some 50 heads of research councils — mostly from countries within the G20 and the Organisation for Economic Co-operation and Development — collectively developed a set of principles for effective merit review…" (emphasis in the original, *Suresh 2012a*, page 337). Suresh then lists the Merit Review Principles (see above, *NSF Statement 2012* or *NSF Global Summit 2012)*. This section concludes "…The fact that so many of the world's leading science-funding agencies voluntarily and unanimously endorsed such a public statement is a crucial step towards increasing collaborative transnational research agreements…" (*Suresh 2012a*). To the best of my understanding, this means that the Merit Review Principles may promote cross-border funding, and therefore, facilitate international research collaboration. I looked through Publications on the Global Research Council Website. I could not find an indication that the Merit Review Principles transformed the international research funding landscape. There are no examples listed on the Global Research Council website of cross-border projects made possible or facilitated by the publication of the Merit Review Principles; unless of course such information is protected by the Merit Review Principle of *Confidentiality*, in which case the Merit Review Principle of *Transparency* is not relevant.
- The second recommendation by Suresh is to "…**Share resources to increase the scope and global impact of scientific experimentation**…" (emphasis in the original, *Suresh 2012a*, page 338). Several examples of successful global research ventures are mentioned, such as Atacama Large Millimeter/Submillimeter Array (ALMA) telescope and CERN. Suresh did not mention if his work at the National Science Foundation and later Global Research Council contributed to the success of these ventures cited as examples.
- The third recommendation by Suresh is to "…**Explore new ways to share the research output of major scientific infrastructure projects**. Given that scientific credit is measured by priority, publications and patents, collaborative research output should be shared among all involved…" (emphasis in the original, *Suresh 2012a*, page 338). Note that *publications* are mentioned, and that Suresh had earlier stated under "…**FOUR RECOMMENDATIONS**…" that "…Scientists need to be assured that data generated through cross-border collaborations meet certain standards of quality and research integrity, and that they will be preserved and accessible to other researchers…". In other words, open access is implied. This is confirmed by the press release from the Global Research Council Summit of 2013: "…DFG-President Professor Peter Strohschneider stressed the relevance of "Open Access" to publications as a main paradigm of scientific communication in the following years. The participants agreed that sharing research publications openly is a means to increase the quality of research communication and thus of research itself…" (*GRC Summit 2013)*. It is therefore worrying that Suresh makes no mention of open access while discussing his recommendation on how to share research output. However, "…[G]uidelines for implementing open access to scientific publications and data…" (*Suresh 2012a*, page 338) is mentioned in the concluding paragraphs of the article, under "…**BETTER TOGETHER**…" (*ibid*), and although 'publications' is again mentioned, open access of the same is not addressed. Instead, under this section of the article about sharing 'research output', Suresh mentions data sharing facilitated by the Antartic Treaty and ALMA, which is 'big data', elaborated in his fourth recommendation, below.
- The fourth and final recommendation made by Suresh is to "…**Develop policies and mechanisms to guide the collection, analysis and distribution of 'big data**'…" (emphasis in the original, *Suresh 2012a*, page 338). As in the section on sharing research output, a telescope is mentioned, not ALMA

under this recommendation, but the Large Synoptic Survey Telescope. Suresh writes "…Over the past few years, new scientific instrumentation, computational hard-ware and software, and theoretical analysis have markedly increased the sophistication, resolution, reach and scope of data collection, generating huge data sets…Such volumes of data have to be organized, manipulated, integrated, distributed and stored — a process that poses major challenges. Together, funding agencies, research institutions and scientists must develop new ways to extract useful knowledge from mountains of information. Funding agencies must support studies of data gathering, *access* and storage so that information creation does not streak too far ahead of information curation…" (*Suresh 2012a*, page 338). These statements, along with those made in the third recommendation, to facilitate research output sharing (without open access) may suggest that these huge datasets will be made available to researchers who cannot afford to collect, organize, store, so on, and who will wish to *access* the data and thus contribute to the global challenges outlined by Suresh. It is therefore difficult to interpret the sentence following immediately to those just quoted: "…Policies must be formulated to ensure the privacy and confidentiality of sensitive data, and to safeguard intellectual-property rights and cyber security…" (*Suresh 2012a*, page 338). Is Suresh suggesting here that policies to "…ensure the privacy and confidentiality of sensitive data…" (collected by telescopes, from subatomic particles, or at the Antarctic?), as well as to protect intellectual property, will facilitate collection, analysis, or distribution of big data?

- Suresh writes "…I am convinced that greater collaboration will maximize the effectiveness of those investments. Without a coordinated global response, humanity will not overcome the challenges it faces. That is why I have strongly supported the efforts of the US National Science Foundation (NSF) to harmonize global research initiatives among science-funding agencies…" (*Suresh 2012a*, page 337). Recall that elsewhere Suresh had recommended "…harmonizing the standards that underlie different national systems…[to]…create the smoothly operating system of global science essential to addressing the world's most pressing challenges…" (*Suresh 2012b*). Harmonizing 'global research initiatives' is not the same as harmonizing 'standards that underlie different national systems'. The latter may facilitate international research collaboration, the purported aim. The former implies a form of top-down control and an hegemonic outlook, targeted at "…so many of the world's leading science-funding agencies…" (*Suresh 2012a*), or governmental funding agencies. If Suresh's aim is to harmonize 'global research initiatives', then would it not be worrying if indeed "…agencies voluntarily and *unanimously* endorsed such a public statement…" (emphasis added, *Suresh 2012a*)?

5.5. *Alberts et al. 2015*: RESEARCH INTEGRITY IS THE SCIENTIFIC RECORD AND HYPE

- The article *Alberts et al. 2015* is co-authored by Suresh, published in *Science*, and is titled 'Self-correction in science at work: Improve incentives to support research integrity', and comes under a SCIENTIFIC INTEGRITY section of the journal. Integrity in the article as discussed implies only reliability of the scientific record and reproducibility.
- The article discusses integrity only in the context of the scientific record and reproducibility. That 'research integrity' is limited to the 'scientific record' by Suresh and others is affirmed, repeatedly, and from various perspectives adopted for the purpose of this assumption. To quote a few examples from the article: "…Consistent with their self-correcting norm, scientists are actively addressing the disconcerting rise in *irreproducible findings and retractions*…Data have begun to *require reproducibility in accepted papers*…In cases in which the institution is unwilling, conflicted, or incapable of investigating, consequential *flawed findings might linger in the literature…Journals should continue to ask for higher standards of transparency and reproducibility*…Even when institutions, funders, and journals work in good faith to address misconduct and *ensure the accuracy of the research record*…" (emphasis added, *Alberts et al. 2015*, page 1421).

- The introductory paragraph of the article states "…Week after week, news outlets carry word of new scientific discoveries, but the media sometimes give suspect science equal play with substantive discoveries. Careful qualifications about what is known are lost in categorical headlines…"; also researchers should ensure that "…their public information offices avoid hype in publicizing findings…" (*Alberts et al. 2015*). In light of the evidence presented here, on publicity generated for Suresh, and the nature of the outcome of projects led by or involving Suresh, was this statement meant to be ironical or was it self-descriptive?
- The article goes on lauding the "…self-correcting…" nature of scientific investigation.
- The responsibility for ensuring research integrity, or alternatively and as assumed in the article, integrity of the scientific record, is explained in categorical but contradictory terms in the article. "…Ensuring that the integrity of science is protected is the responsibility of many stakeholders…", namely institutes, funding agencies, and and journals. However, "…journals lack the wherewithal to investigate allegations of misconduct in published research…". "…Funding agencies often play an oversight role…", suggesting that ensuring integrity of the scientific record is not a consistent responsibility of funding agencies. It is claimed that "…In cases in which the institution is unwilling, conflicted, or incapable of investigating, consequential flawed findings might linger in the literature… [and so] A more robust structural solution is needed…" (*Alberts et al. 2015*). Clearly, if the responsibility for preserving research integrity, or integrity of the scientific record, is largely (or effectively totally) the responsibility of institutions who might be unwilling or incapable of doing so, then a solution is indeed needed.
- To preserve research integrity, or integrity of the scientific record, "…Authoritative and timely investigations into allegations of misconduct are critical to ensuring that flawed findings, which because of fraud or misconduct cannot be redeemed, are formally decertified…" (*Alberts et al. 2015*). Mechanisms in place to correct the scientific record are discussed. The negative consequences of correcting the scientific record for researchers and institutions are highlighted, and alternative mechanisms to correct the scientific record while mitigating negative repercussions are proposed. In light of this, are we to understand that an 'unredeemed' incident of misconduct is 'formally decertified' by an article retraction?
- The article states "…The peer-review process should do a better job of mentoring young reviewers, increasing the clarity and quality of editorial response, and uncovering instances in which a reviewer is biased for or against a particular work…" (*Alberts et al. 2015*). How can this be interpreted, notably with regards editorial practice, given that for example Suresh with others published over twenty (20) articles some apparently duplicated in *PNAS*?
- The article states "…"conflict of interest" implies that disclosed relationships are corruptive. Adopting more neutral language such as "disclosure of relevant relationships" may encourage more complete compliance without implying that all disclosed associations are sinister…" (*Alberts et al. 2015*).[13] Why did Suresh not disclose relevant relationships consistently, for example regarding patents related to a published work?
- The article ends by suggesting that science and politics are comparable. It is not clear which, science or politics, was suggested to be more or less corrupt.

[13] This is identical to a recommendation produced by the 2015 Annenberg Retreat at Sunnylands organized by Ralph Cicerone, see https://www.annenbergpublicpolicycenter.org/nas-appc-sunnylands-retreats-integrity-science/

5.6. *Suresh and Bradway 2016*: TAXABLE SCIENTIFIC OUTPUT

- The editorial published by Suresh and Bradway (2016) in *Science* is titled 'Business backs the basics'. The piece was produced in the context of a retreat organised in 2016 by The Annenberg Foundation Trust at Sunnylands, the Annenberg Public Policy Center (of the University of Pennsylvania), and the National Academy of Sciences.[14] The purpose of the "…leaders who gathered for the "CEOs and Leaders for Science" was to address the implications "…Why?…basic research will make or break corporations in the long term…" (*Suresh and Bradway 2016*, page 151).
- It is understood that "…Long-term basic research, substantially funded by the U.S government, underlies some of industry's most profitable innovations…" (*Suresh and Bradway 2016*, page 151). However, "…For decades, the private sector has withdrawn from some areas of basic research…" for various reasons, and "…industry finds itself unable to invest in basic research the way it once did…". "…Consequently, business leaders assembled at Sunnylands resolved to use their individual and collective credibility, and their stature as heads of enterprises that fuel the economy, to advocate for greater government support for basic scientific research to revitalize the science eco-system…" (*Suresh and Bradway 2016*).
- "…With that in mind, the CEOs will partner with academic leaders to educate the public about the importance of basic research…The hope is that this concerted action positions basic research atop the next U.S. president's agenda…" (*Suresh and Bradway 2016*).
- The editorial also highlights the attraction of the U.S. research and education industry to talented foreign students.
- The messages communicated in this editorial are comprehensively presented in a publication produced by the National Science Board (National Science Foundation), of which in 2012 Suresh was the Director (listed as member *ex officio* in this document and others, *National Science Board Indicators 2012)*.
- The messages communicated in this editorial are related to to the title of a comment published in *Science News*, 'Basic research generates jobs and competitiveness' (*Witze 2011*); it is important to note the editorial is linked to the article in *Science News* only by way of the title of the article, not the content. The content, which was generated after "…Science News *contributing editor Alexandra Witze spoke with Suresh and compiled these comments from the interview and his lecture*…" (emphasis in the original, *Witze 2011*, page 32), does not appear to be directly relevant. For example, Suresh's reply to the question "…What is the value of basic research in these tough economic times?…" (emphasis removed, *Witze 2011*) appears to be that it is taxable and 'provides returns'; and Suresh's reply to the question "…So what's out there waiting to be discovered?…" was "…We can understand the world, ourselves included, and with that knowledge help resolve the major dilemmas facing society today…" (*Witze 2011*).

5.7. Discussion of Suresh's work in research management and globalization

- The messages communicated by Suresh as well as others with regards to international collaboration and research funding are summarized below. These messages are communicated in the editorials and articles published by Suresh and others, as well as publications produced by the National Science Foundation and Global Research Council.
- Integrity is claimed to be paramount to the research process and the success of international collaboration; this is emphasized in hyperbolic terminology both in publications produced by Suresh

[14] I could not access the link mentioned in the editorial (www.annenbergpublicpolicycenter.org/business-leaders-agree-u-s-funding-of-basic-research-advances-prosperity-security-well-being/). The following link is accessible: https://www.annenbergpublicpolicycenter.org/nas-appc-sunnylands-retreats-integrity-science/

as well as publications produced by the Global Research Council. In the editorials produced by Suresh as well as publications from the Global Research Council, responsibility for ensuring research integrity belongs to the institute. This message is somewhat confirmed by the Global Research Council in that "…researchers and institutions themselves remain ultimately responsible for undertaking research with integrity…" (*GRC Statement Integrity 2013)*.

- In *Alberts et al. 2015*, Suresh and others define 'research integrity' as accuracy of the sceintific record and reproducibility. The expressed position of the Global Research Council on what consistutes integrity ("…the very essence of the scientific enterprise…" *etc.*, *GRC Statement Integrity 2013)* is not clear. In the Statement: "…research funding agencies have an obligation to ensure that the research they support is conducted in accordance with the highest standards possible…" (*ibid*). Funding agencies are to do this by encouraging institutions to promote integrity, promoting *continual* training on research integrity for researchers and students, and incorporating research integrity as a condition to obtain and maintain funding. Importantly, "…During any investigation of misconduct, research funding agencies should *support a process* that values accountability, timeliness and fairness…" and 'misconduct' is defined in a footnote thus: "…Breaches of research integrity can include, but are not limited to, plagiarism, fabrication and falsification…" (emphasis added, *ibid*). In other words, 'misconduct' is defined by the Global Research Council in a footnote of its 'Statement of Principles for Research Integrity' in a manner that is not aligned with a much broader understanding of 'integrity' implied elsewhere in the main text of the same document. For example, it is suggested in the main text of the Statement that integrity involves *conduct* of research and not only outcome, and that there are "…responsibilities of research funding agencies in creating an international environment in which research integrity is *at the core of all activities*…promote integrity *in all aspects of the research enterprise*…" (emphasis added, *ibid*). Since plagiarism, fabrication, and falsification can only occur in the scientific record, the definition of misconduct (breach of integrity) made by the Global Research Council appears more in line with Suresh's definition of integrity (that integrity is accuracy of the scientific record), and less in line with colorful references to integrity made in the main text of the document.[15]
- Peer review of scientific publications, peer review of grant proposals, and merit review of grant proposals are conflated by Suresh in editorials and articles he published, probably warranting the lengthy disambiguation published by the Global Research Council in 2018. Merit Review was disambiguated from Peer Review by the Global Research Council thus: "…For some participants the term Merit Review is used to distinguish the wider assessment of the merits of a proposal, beyond just the 'peer review' of scientific excellence by scientific peers, such as the potential relevance to beneficiaries or potential impact of the proposal…" (*GRC Merit Revised 2018)*.
- It is important to discern the conflated and purported aim(s) of Suresh's work on research globalization, whether it is to 'harmonize global research initiatives', or to 'harmonize standards that underlie different national systems', particularly since "…agencies voluntarily and *unanimously* endorsed such a public statement…" (emphasis added, *Suresh 2012a*). If the aim of Suresh's work is harmonize what may be 'standards that underlie national systems', this could facilitate international research collaboration, for example, by encouraging funding agencies of participants to commit to the Global Research Council 'Statement of Principles on Peer/Merit Review 2018' (*GRC Merit Revised 2018)*. That is, a 'standard' of assessing grant proposals. However, if the aim of Suresh's work is to

[15] Interestingly, this discrepancy may be explained by what I was told by Roderick Wayland Bates, Research Integrity Officer at Nanyang Technological University. When I reported illegal animal experiments and sytemic misconduct in the research and academic activity of my then-Reporting Officer, Rupshi Mitra, Bates told me to "…present evidence of misconduct *in publications*…". When I asked for a clarification, he said that "…As far as I [Roderick Wayland Bates] am concerned, if it's not published, it's not misconduct…". As it happens, not one article produced by Rupshi Mitra at Nanyang Technological University, as well as those of of her spouse, Ajai Vyas, is free of evidence of misconduct. In addition, academic misconduct is evident in doctoral theses and Final Year Projects supervised by Rupshi Mitra and Ajai Vyas. Please see the full report on www.nanyandscandal.com.

'harmonize global research initiatives', then we need to know: who is deciding these *global research initiatives*? Obviously, "…potential relevance to beneficiaries or potential impact of the proposal…" (*GRC Merit Revised 2018)* are unlikely to be harmonized spontaneously, given that the wider assessment of Merit Review takes into consideration both relevance to beneficiaries and the potential impact of a proposal which will, or should, vary from one funding agency to another.[16] A purpose of the Global Research Council is to "…To respond to opportunities and to address issues of common concern in the support of research and education…" (*GRC 2021*). Did Suresh equate 'responding to opportunities to address issues of common concern' with 'harmonizing global research initiatives'?

[16] Regarding beneficiaries, see '2020/1 GRC Statement of Principles on Public Engagement' (*GRC_Public_Engage_Statement 2020*); although it is stated that "…Knowledge emanating from publicly funded research belongs to the public…", it is also stated that "…GRC participants…Recognise public engagement as purposeful and meaningful activities facilitated between researchers and their various 'publics', whereby the co-construction of knowledge is enhanced, and mutual learning generates benefits for all…" (*ibid*). Regarding putative harmonization of global reserarch initiatives, see '2020/1 GRC Statement of Principles on Mission-Oriented Research' (*GRC_Statement_Mission 2020*). In this document, "…Mission-oriented research…" will "…integrate capacities from a broad range of stakeholders, scientific disciplines and sectors, adopting new modalities and developing new capacities, underpinned by effective and mutually reciprocal knowledge exchange practices…" and is "…outcome-oriented…" (*ibid*). However, "…Commonalities and diversities of countries should also be taken into account in the design and implementation of missions…" while at the same time "…missions should also provide opportunities for and relate to curiosity-driven science as well as strategic research…" but nevertheless "…national and local priorities, contexts, capabilities and strategies must also be appropriately recognised and integrated into the scope and approaches of the missions, alongside the broader regional and global frameworks…" and also "…using broader global frameworks, such as the Sustainable Development Goals…" as well as "… a range of frameworks exist that could be adapted to serve as a foundation for such missions. For example, the Convergence Accelerator, funded by the USA's National Science Foundation, leverages partnerships across a wide range of sectors to support use-inspired research in areas of national and global importance…" (*ibid*). In any case "…monitoring and evaluation of missions, as well as effective communication of their impacts, is needed to effectively demonstrate the benefit and value of these missions to wider stakeholders, as well as to garner their wider support and collaboration…" (*ibid*). It is important to note that "…there is a strong and mutually inclusive relationship between the mission-oriented research and public engagement themes, with public engagement recognised as an important component to the design and implementation of missions that are responsive to the needs and interests of the global citizenry…a wide range of publics – such as citizens, but also various civil society formations, the variety of branches of the state, the private and public enterprise sectors, and a myriad of scholarly and academic organisations – are effectively engaged in the identification, development and delivery of missions, as well as benefit from their outcomes and are essential to ensuring consensus and inclusive public engagement with missions…" (*ibid*). In other words, it is not clear if citizens, branches of state, private and public sector, and academic organizations are acknowledged as members of the "…wider stakeholders…" to which monitoring and evaluation of mission-oriented research is to be demonstrated. Furthermore, one of the "…considerations for the desire and need for a collaborative approach by GRC participants in addressing global grand challenges…[is] the continuing ambition of these agencies to pursue shared objectives and voluntary collaboration, in line with the GRC's *Statement of Principles on Capacity Building and Connectivity Among Granting Agencies Worldwide* (2017)…" (emphasis in the original, *ibid*). In the document referred to, it is stated that "…The term 'capacity' refers to the organizational and technical abilities, relationships and values that enable research agencies to *define their goals* and manage their resources in a fair, transparent, and cost-effective manner and, in an increasingly global context, adapt their functions to respond to new developments in science and shape future directions…" and "…the GRC network provides a framework for agencies to learn from each other to support *their strategic directions and accountability*…" (*GRC_Statement_Capacity 2017*). Subsequently, "…programmatic directions…" are made distinct from "…evolving expectations for how research should be governed…", and in a footnote, "…The GRC Statements of Principles on merit review, research integrity and promoting the equality and status of women, are examples of recent efforts to improve research governance…" (*ibid*). In other words, research governance does not include allocation of funding, or 'programmatic directions', regardless of the fact that the GRC Statement on Mission-Oriented research was published after the GRC Statement on Capacity Building. In the latter, "…**Design and Evaluation of Collaborative Research Initiatives**…" could be "…Responding to government, academic and societal interests, coupled with the potential for

- According to the General Research Council Principles, the assessment of grant proposals by governmental funding agencies through Merit Review is ultimately decided by a poorly defined group of stakeholders, beneficiaries, or both.
- Suresh promises that his work, through the National Science Foundation and the Global Research Council will address global challenges head-on, and intimates that his recommendations are the only way to prevent global catastrophe. However, he does not mention concrete evidence of how completed work, for example, the Merit Review Principles, are doing just that, or are working towards such an aim.
- Open Access and big data are obfuscated or confused by Suresh. This is in contrast to the straight-forward Action Plan outlined by other members of the Global Research Council only in 2013, and which includes stakeholders to be addressed such as publishers (see *GRC Summit 2013)*, a point conspicuously absent from Suresh's discourse on 'research output', or 'big data', or 'open access'. However in 2017, the Global Research Council Statement on Capacity Building was published, and it appears to dilute or even retract the Action Plan set out in the 2013 Summit, regardless of whether or not 'Capacity Building' is relevant to 'Open Access'. In the Statement, "…**Transparency and open access to new knowledge and tools**…" refers to "…Actions undertaken by GRC participants should strive to make their respective agencies more accountable and transparent to the public. To the extent possible, the accumulated knowledge, tools and lessons learned should be made available to all current and future GRC participants…" (emphasis in the original, *GRC Statement Capacity 2017)*. In other words, 'open access' is used in this instance ambiguously, misleadingly, or both. Also in this document, "…**Practices and Tools for Research Management and Program Delivery**…Robust policies and information systems enable GRC participants to support the research community and to utilize research management data for accountability and foresight purposes. GRC participants encouraged further exchange and adoption of best practice, and identification of future areas where technology platforms can support research collaboration (e.g., platforms supporting open science) and research management (e.g., sharing of data on research activity, a shared portal for international peer review) …" (*ibid*). There is no reference to the much more comprehensive and meaningful Action Plan laid out in the Summit of 2013. Interestingly, this apparently discarded Action Plan is the *only* Global Research Council achievement mentioned on Wikipedia.[17]
- In a retreat for CEOs convened by Suresh and Bradway (2016), it was agreed that leadership of the private sector would lobby the U.S. government to increase spending on basic research.
- The product of the first Global Research Council Summit (2012) was the Merit Review Principles, directed at government funding agencies. This was later Revised in 2018 to disambiguate the 'peer review' of grant proposals for scientific merit, and 'merit review' of grant proposals which includes broader impact, for example on society, in addition to scientific merit. In his editorials, Suresh obfuscates peer review of grant proposals, and peer review as a process occuring during the

research to spur innovation in industry, inform public policy, and address societal challenges…" (emphasis in the original, *ibid*). Also, for "…**Strategic Planning and Foresight**…GRC participants use strategic planning and foresight methodologies to identify emerging issues and guide their research investments. As developments in science and technology are increasingly shaped by global forces, and as global challenges merit coordinated action, the case for joint analysis and planning increases. GRC participants recognized opportunities to strengthen national capacities and support global research through sharing expertise and experience in leading top-down and bottom-up strategic planning and foresight activities…" (emphasis in the original, *ibid*). These 'Actions' are not only "…promising topics for strengthening *capacity* and connectivity…" but also allow GRC participants "…*to respond to new developments in science and to shape future directions*…" (emphasis added, *ibid*). In yet another document published by the Global Research Council, "…key societal actors who inform debates, *shape the conduct of research* and utilize findings…" are emphasized (*GRC_Statement_Capacity 2017*). In other words, it is not clear and across publications by Suresh and the Global Research Council, neither who the 'wider stakeholders' and 'beneficiaries' are, nor who will be responsible for putatively 'harmonizing global research initiatives'. It may appear that both are the funding agencies.

[17] https://en.wikipedia.org/wiki/Global_Research_Council, accessed May 2021.

publication of novel findings in journals, and an important mechanism for ensuring integrity of the scientific record.

- Starting 2010, while Suresh held the position of Director at the National Science Foundation, the National Science Board "…agreed that a review of the National Science Foundation's (NSF) Merit Review Criteria was a priority…Ultimately, the Board did not change the two Merit Review Criteria, which remain Intellectual Merit and Broader Impacts. However, the Board did work to define more clearly the two Criteria in hopes that the NSF community has a better understanding of each criterion and how they relate to one another…" (*NSF Merit Review 2011*, page vi).
- The first release from the National Science Board was not well-received, and so "…solicited and received input from several stakeholder groups both internal and external to NSF, involving several thousand individuals…" (*NSF Merit Review 2011*, page 6).
- The revised edition was released in 2011 and Merit Review Criteria are defined as: "…**Intellectual Merit:** The intellectual Merit criterion encompasses the potential to advance knowledge; and **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes…" (emphasis in the original, *NSF Merit Review 2011*, page 2). The document comprehensively and thoroughly describes these Merit Review Criteria, and presents the data used to generate them.
- The publication of the Merit Review Criteria by the National Science Foundation in 2010 was crticised in the media. For example, "…The latest attempt to clarify how NSF assesses grant proposals for possible impacts beyond the expected scientific results has not ended a long-running debate…" (*Mervis 2011*). An article was published in 2010 titled 'Making judgements about grant proposals: A brief history of the Merit Review Criteria at the National Science Foundation' (*Rothenberg 2010*). An article was published in 2011 addressing various aspects of the science system including funding agencies (*Leshner 2011*).
- The purpose of reviewing the scientific merit as well as potential and broader impact of a grant proposal is, obviously, to facilitate the process of making a decision on which grant proposals are to be funded.
- Since Sureash *already knew* from his experience at NSF that Merit Review and Peer Review, and Intellectual Merit and Broader Merit are points of significant contention and confusion, *why did he not clarify these points when setting up the Global Research Council*, instead of apparently and deliberately obfuscating them from the get-go?

6. PATENT APPLICATIONS BY SURESH AND OTHERS

- A number of patent applications by Suresh and others are collated in Tables 6., 7., and 8.
- The total number of patent applications and patents analyzed is about 70, and were published between the period 1997 and 2020.
- The applications were made to the World Intellectual Property Organization (WO), United States Patent and Trademark Office (US), European Patent Organisation (EP), Korean Intellectual Property Office (KR), Deutsches Patent- und Markenamt (DE), IP Australia (AU), Japan Patent Office (JP), and China National Intellectual Property Administration (CN).
- To the best of my knowledge, Suresh with others were *granted* 14 patents between the period 1998 and 2015. It is possible some patents were granted as a renewal of an earlier patent or patent application.
- Of those 14 patents granted, 12 were granted in the US Patent Office, one in Korea, and one in Europe Patent Organisation.
- Suresh and others appear to regularly make patent applications to various patent offices around the world. At the European Patent Organisation and the World Intellectual Property Organization, Suresh's patent applications invariably receive a report indicating lack of novelty or lack of unity of the invention. Frequently, the Inventors are invited to further support their claim, or pay fees for further search and reporting by the patent office. The Inventors do not, and after a period of time, the application is deemed withdrawn, or is considered abandoned.
- Several patents granted appear to have been re-assigned, meaning that the original 'Asignee' was changed. For example, one patent, US6513389 (B2), over its lifetime was re-assigned from California Institute of Technology, to Venture Lending & Leasing IV Inc. (operated by Western Technology Investment), and later reassigned to Veeco Instruments Inc., and later to KLA Corporation.
- Given that Suresh with others:
    i. Make the same patent applications to patent offices;
    ii. Make similar patent applications with some variation over a period of time;
    iii. Abandon the significant majority of patent applications made, or show no interest to follow up on the application or defend the patent's claim;

    …we may assume that the purpose of the majority of Suresh's patent applications, especially those made to patent offices outside the US, is not to have a patent granted.
- On speculation, the purpose of Suresh's patent applications is to be able to claim to research institutes and funding bodies that patent applications were made.

7. PUBLICITY FOR SURESH

7.1. Numerous publicity pages, news pieces, and so on, generate positive publicity for Suresh, for example that he is one of "…material science and mechanics…most profound contributors alive today…" and "…In recognition of his stellar academic achievements, the NTU Board of Trustees appointed him the inaugural Distinguished University Professor…" and so on see *Suresh publicity pages 2021*.

8. THESES SUPERVISED BY SURESH

8.1. PLAGIARIZED MASTER THESIS SUPERVISED BY SURESH

- Table 9. shows that the Master's thesis supervised by Suresh, *Hardin 2006*, is plagiarized from another Master's thesis supervised by Suresh, *Zhang 2007*.
- Both Master's theses broadly discuss putative marketing of a device for diagnosis of malaria. Though both theses were submitted in partial fulfillment of a Master of Engineering at Massachuttes Institute of Technology, any engineering component of the discussion is obfuscated and in any case irrelevant to the aim of the study, which is the marketing of such a device.
- There are two notable differences between these theses:
    i. In *Hardin 2006*, it is noted (with some alacrity) that the market for a malaria-diagnosis device is not propitious because malaria is endemic in developing countries who would not afford it. It is therefore suggested that the technology of the device be somehow modified for cancer diagnosis, to target elderly and rich customers in developed countries.
    ii. Both *Hardin 2006* and *Zhang 2007* are exceedingly concerned with extracting maximum profit from the device, and for the longest period of time possible. To achieve this, one thesis suggests placing a general description of the device in the first patent, the other suggests placing a specific description of the device in the first patent.

8.2. ANALYSIS OF OTHER THESES SUPERVISED BY SURESH PENDING

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Table 1. Theses supervised by Robert O. Ritchie and final Lab Report		
#	**Doctoral thesis: *Suresh 1981***	
	Text quoted from *Suresh 1981*; finding claimed by Suresh	**Original reporting of finding**
1	Pages 109-112: "…9. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH Based on a study of ambient temperature corrosion fatigue crack growth in SA542-3 pressure vessel steel, SA516 low strength steel, X-60 pipeline steel and 2021 aluminum alloy, the following conclusions can be made:…"	
2	"…1. Lower strength steels undergo significant accelerations in fatigue crack propagation rates due to the presence of hydrogen gas in mid-growth regime (growth rates in excess of $10^{-\delta}$ mm/cycle) as well as in near-threshold region (growth rates smaller than 10^{-6} mm/cycle) at stress intensities far below the K_{ISCC} threshold for hydrogen-assisted cracking under sustained loading. Mechanisms for the influence of hydrogen in these two regimes are entirely different…"	Work by *Conley 1980* and *Moss 1980(?)*.
3	"…2. In the mid-growth regime of abrupt crack propagation, accelerations in crack growth rates which depend on frequency, load ratio, and hydrogen pressure, are associated with a characteristic intergranular fracture mode and seem to be specific to gaseous hydrogen and hydrogen containg/producing environments. It appears that such enhanced crack growth rates result from "hydrogen embrittlement" mechanisms…"	Mechanism hypothesis in *Ritchie 1977*. Discussed in *Zamiski 1980*.
4	"…3. At near-threshold levels, below $10^{-\delta}$ mm/cycle, growth rates in dry gaseous hydrogen and helium are larger than those compared to moist air and wet hydrogen by up to two orders of magnitude , with threshold ΔK_0 values approximately 40% higher in air. On the other hand, near-threshold propagation rates in distilled water are marginally lower compared to those in air…"	Reported by *Conley 1980* for a different sample, relevant sample work by *Moss 1980(?)*.
5	"…4. Contrary to the behavior associated with crack propagation in the mid-growth regime, there is no characteristic fracture mode for environmental infuences near threshold…"	Redundant.
6	"…5. The corrosion products formed in the specimens tested at ambient temperature have been identified using ESCA analysis to be predominantly Fe_20_3 in steels. It is found that the oxide thicknesses are inversely related to crack growth rates. The thickest oxide formation is observed at near-threshold growth rates at low load ratios in moist environments and is several times larger than that observed at high load ratios or on specimens of the same material exposed to the same environment for same length of time…"	Reported by *Zamiski 1980* though it is unclear what the latter part of the paragraph is referring to, perhaps data from *Conley 1980* or then from *Moss 1980(?)*.
7	"…6. Environmental influences near threshold are explained based on the concepts of a new mechanism termed "oxide-induced crack closure". According to this model, low stress intensity growth rates are accelerated in hydrogen compared to air, not because of hydrogen embrittlement per se, but due to reduced amount of crack closure resulting from less oxide debris formation on crack surfaces…"	Discussed in *Zamiski 1980*. Hypothesis on embrittlement mechanisms in *Ritchie 1977*. Hypothesis on oxide-induced crack closure in *Paris et al. 1972* and elaborated in *Stewart 1980*.
8	"…7. Concepts of oxide-induced closure are consistent with observed effects of load ratio, strength level, fracture morphology, and environment on near-threshold behavior and further are in accord with observations that inert environments accelerate near-threshold growth rates compared to distilled water…"	See point #7 above.
9	"…8. Despite the normal uncertainties involved in oxide thickness measurements, it can be inferred that the excess oxide debris on the crack flanks is roughly of the order of the cyclic crack tip opening displacement at the threshold…"	I'm not sure what Suresh means here.
10	"…9. Measurement of closure near threshold using ultrasonic techniques clearly demonstrate the increased amount of closure in moist air compared to dry hydrogen, even though precise measurement of closure loads could not be made. It is also seen that crack opening may not be a spontaneous phenomenon, but a rather gradual process with crack surfaces remaining in contact locally, while globally the crack can be considered fully open…"	Perhaps this is the only original contribution of data in *Suresh 1981* by Suresh. It is discussed in the thesis under "…5. EVIDENCE SUPPORTING OXIDE-INDUCED CRACK CLOSURE…" and not under "…2. MATERIALS AND EXPERIMENTAL PROCEDURES…".

11	"…10. Block underload cycles at alternating stress intensities below the threshold can result in significant transient retardations in initial growth rates when cycling is subsequently resumed at baseline ΔK_B levels, the magnitude of the effect being critically dependent upon underload (ΔK_u) and baseline (ΔK_B) stress intensities. This behavior appears to be consistent with the arguments of oxide-induced crack closure. The lack of such crack growth retardation effects for certain combinations of underload and baseline load levels is found to occur when pulsating crack tip displacements at the underload are smaller than the existing excess oxide thicknesses…"	See point #4 and point #7 above. 'Crack growth retardation effects' probably refers to a mechanism suggested by *Elber 1971* and discussed in *Zamiski 1980*.
12	"…11. In addition to mechanisms generated by corrosion debris, sources of enhanced crack closure from fracture morphology and roughness may arise at near-threshold levels because their size scales are comparable to crack tip displacements…"	See point #7 and point #9 above.
13	"…12. Near-threshold data in 2021 aluminum alloy reveal that the concepts of oxide-induced crack closure may not be valid in all the materials that are capable of readily forming oxide films. Thick oxide formation at low growth rates may depend on how tenaciously the oxide is attached to the fracture surfaces…"	It is not clear why this is included here. Aluminium alloy data is in *Fuquen-Molano 1982* but in that thesis it is relevant show temperature-dependence of a process. Obviously, oxidation formation in steel and aluminium are different, so Suresh including aluminium *data*, without relevance to findings is puzzling, as is this generic statement.
14	Pages 113 to 114 "…SUGGESTIONS FOR FURTHER RESEARCH…further research needs to be conducted to elucidate the mechanism of excess oxide debris formation…properties of the oxide itself need to be studied in detail….further studies on chemical reaction kinetics and hydrogen diffusion are required to substantiate the currently-known concepts…conceptually appealing…A systematic approach to aid design philosophies is needed…"	
#	**Bachelor thesis: *Conley 1980***	
15	Pages 49-50: "…CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS A rising load K_{ISCC} test was used to estimate the threshold stress intensity for crack growth under sustained loads in gaseous hydrogen (P_{H2} = 138 kPa = 20 psig), for a 300-M ultrahigh-strength steel, tempered for 1 hr. at 300°C. This estimate was evaluated for use in the superposition model to predict the fatigue crack growth curves in a gaseous hydrogen environment. The K_{ISCC} was estimated to be 34.4MPa√m(31.3ksi√in). From this study the following conclusions can be made: 1. The rising load K_{ISCC} test (K = 1.1MPa√m/min = 1.0ksi√in/min) overestimated the K_{ISCC} (as determined by the standard method) by 85%. 2. The estimated K_{ISCC} did not adequately predict the cyclic crack growth curve in gaseous hydrogen of 300-M, tempered at 300°C, for load ratios of 0.05 and 0.30 at a cycling frequency of 50 Hz. 3. In the superposition model, the standard, static-load K_{ISCC} value predicted the onset of stress corrosion cracking, but did not accurately predict the increase in crack growth rates for a load ratio of 0.05. 4. The model might better predict the crack growth curves in hydrogen if, (a) the rising load K_{ISCC} test was performed at a lower loading rate; perhaps K = 0.1 MPa√m/min. (b) sustained load crack growth curves were obtained of 300-M (tempered at 300°C) in gaseous hydrogen…"	
16	Page 8: "…Cracks initiate and propagate from material flaws. It is safe to assume that flaws exist and that somewhere a crack will initiate. It is then important to know how fast the crack will propagate so that inspections can detect cracks before they lead to eventual fracture. K_{ISCC} is the plane-strain stress intensity factor below which an existing crack will not grow due to stress corrosion. A standard K_{ISCC} test consists of applying a constant load for typically 1,000 hrs. in the corrosive environment. The stress intensity below which no cracks will propagate, at least over the 1.000 hr. period, is taken to be K_{ISCC}. This test does not, unfortunately, produce reliable results for use in all designs. Values of K_{ISCC} will vary, depending upon the patience of the experimenter…"	
17	Pages 8 and 10: "…The standard K_{ISC} test is a static load situation, and cannot predict the crack growth behavior in cyclic loading. A method is needed to predict the cyclic crack growth behavior in hydrogen, and one that will take less time than the 1,000 hrs. of the standard K_{ISCC} test. Wei and Landes (1969) have proposed a superposition method of determining the fatigue crack growth behavior of high-strength steels in hydrogen, at stress intensities above K_{ISCC} (3) [Wei, R.P., & Landes, J.D., "Correlation Between Sustained-Load and Fatigue Crack Growth in High-Strength Steels", Mat. Res. & Stds., July 1969, p. 25]. This method consists of	

	superimposing the cyclic crack growth curve in air with a monotonic crack growth curve in hydrogen to predict the cyclic crack growth curve in hydrogen (Fig. 1). To shorten testing time, this project seeks to evaluate whether an accelerated K_{ISCC} test, called a rising load K_{ISCC} test, can be used to determine the monotonic environmental contribution to the superposition model for high-strength steels…"
18	Page 21, 22, 28, and 30: "…For high-strength steels, intergranular cracking along prior austenite grain boundaries is often indicative of hydrogen embrittlement (13) [Broek, D., Elementary Engineering Fracture Mechanics, Sijthoff & Noordhoff, The Netherlands, 1978, p. 62]. The fracture surface should be examined; if the fracture mechanism was not affected by the hydrogen throughout the test, the loading rate, K·, was much too fast, and the test should be repeated at a slower K… …An accelerated K_{ISCC} test was run on a 300-M ultrahigh-strength steel, tempered for 1 hr. at 300°C. This steel is a silicon modified AISI 4340 steel used in the aircraft industry (vacuum-arc remelted). Its composition is as follows (wt.%):…It has essentially the same composition as AISI 4340, with 1.4% of silicon added…Ritchie (2) [Rittchie, R.0,, Cedeño, M.H, Zackay V,F., & Parker, E.R., "Effects of Silicon Additions and Retained Austenite on Stress Corrosion Cracking in Ultrahigh Strength Steels", Met. Trans., Vol, 9A, Jan. 78, p. 35] has found the addition of silicon decreases Region II stress corrosion crack growth rates, but does not change K_{ISCC} (as measured by the standard method)… …Figure 6 shows the K_{IC} test record. K_{IC} was calculated according to Sec. 2.6; calculations are in Appendix B.…Fracture was by microvoid coalescence (Fig. 7)… …For the first rising load test in gaseous hydrogen, the load was ramped so that the stress intensity would range approximately from 0 to K_{IC} in 10 min…Examination of the fracture surface showed very little intergranular cleavage, suggesting that the hydrogen did not have enough time to diffuse ahead of the crack tip… The second test was run over a longer period of time; the load was ramped so that the stress intensity would range approximately from O to K_{IC} over a period of 1 hr… The specimen was placed in the hydrogen environment for 1 hr. before loading. Examination of the fracture surface showed that the fracture mechanism was intergranular throughout (Fig. 8)… …Clark and Landes (1976), in evaluating rising load K_{ISCC} testing in gaseous hydrogen, showed that the rising load K_{ISCC} value varies with the loading rate, K·. (14) [Clark, W.G, & Landes, J.D., "An Evaluation of Rising Load K_{ISCC} Testing", ASTM STP 610, 1976, p. 108]… …Figure 9 shows that for a slower K· a lower K_{ISCC} may be obtained. For the steel used in this project it would be advantageous to run a rising load K_{ISCC} tests at a K· of 0.1 MPa√m/min (0.1 ksi√in/min) to see how much K_{ISCC} varies with loading rate… …The rising load K_{ISCC} (measured with K = 1.1 MPa√m/min = 1.0 ksi√in/min) will be used as an approximation for K_{ISCC} in the superposition model. A rising load K_{ISCC} at a lower K· would be a better approximation…" [Please note the '·' after the 'K' in the original text is placed above the 'K', and not adjacent as written here]
19	Page 32 and 33: "…The superposition model seeks to comprehensively treat environmentally enhanced crack growth under sustained load, "stress corrosion cracking", as well as cyclic loading, "corrosion fatigue", as the same problem. Studies by Johnson, Hancock, and Wilner (5,6) [5. Johnson, H.H., & Wilner, A.M., "Moisture and Stable Crack Growth in a High Strength Steel, "Applied Materials Research, Vol. 4, 1965, p. 34; 6. Hancocl, G.G., & Johnson, H.H., "Hydrogen, Oxygen, and Sub-Critical Crack Growth in a High Strength Steel", Transactions, Metallurgical Soc., Institute Mining, Metallurgical, & Petroleim Engrs., April 1966] suggest that the fracture mechanism is the same in both stress corrosion cracking and corrosion fatigue. They looked at the predominant paths of fracture in a 18 Ni (250) maraging steel tested in dehumidified hydrogen and found them to be the same for both sustained load and cyclic load. While the cycling frequency was found to affect the crack growth curve of this steel in hydrogen, it had no effect in argon (an inert environment) (3) [Wei, R.P., & Landes, J.D., "Correlation Between Sustained-Load and Fatigue Crack Growth in High-Strength Steels", Mat. Res. & Stds., July 1969, p. 25]. This evidence suggests the frequency effect is due to the hydrogen environment, rather than a rate dependence of the material itself. For the above reasons Wei and Landes conclude that the cyclic crack growth of high-strength steels in hydrogen consists of two components, an environmental one and a mechanical one…"
#	**Master's thesis: *Zamiski 1980***
20	Page 2: "…ABSTRACT Near-threshold fatigue crack propagation has been examined for a 2 1/4 Cr - 1 Mo quenched and tempered steel - SA542 class 2. The effects of material strength, load ratio and environment were investigated. Tests were conducted at ambient temperature in a newly constructed environmental chamber system with a design impurity level of 1 ppm. Environments consisted of moist air, and dehumidified/purified hydrogen and helium gases. Near-threshold growth was found to be dependent on material strength and load ratio. Near-threshold growth rates were enhanced inhydrogen and helium relative to moist air. Fractography displayed fracture mechanism dependence on stress intensity, load ratio and environment. The results are rationalized in terms of a crack closure model involving enlarged oxide debris formed upon near-threshold cracks. Such models are shown to be at least qualitatively consistent with experimental observations…"
21	Page 76: "…seemed to question the hydrogen embrittlement mechanism. A new model that tends to explain these results is 'oxide induced crack closure'. This model is based on measurements showing an increased oxide layer on the fracture surfaces for tests in moist air at locations of near-threshold growth. This increased oxide layer (30x a naturally formed layer) is explained by fretting oxidation, whereby crack closure of the surfaces causes oxide cracking, reoxidation and thus a buildup of oxide. The effect of this oxide is to

	increase closure and decrease near-threshold growth rates. This model states that the large difference in near-threshold growth rates is not due to hydrogen (or helium) increasing growth, but rather to moist air slowing up growth…" (underlined in the original).
22	Page 77: "…The oxide induced crack closure model may explain this independence because this model is based on surface phenomena…"
23	Page 30-34: "…3.2 INFLUENCE OF MATERIAL STRENGTH ON NEAR-THRESHOLD GROWTH RATES… …Test conducted on the 320^{0}C temper condition produced questionable results, possibly due to residual stresses present. Therefore the 320^{0}C temper results and problems are described in Appendix B…Several investigators have shown this effect of increasing near-threshold growth rates with increasing mechanical strength. Ritchie (5) [Ritchie, R.O., Metal Science, Vol. 11, 1977 p. 368] reported such a trend in ultra-high strength (yield stress=1000-1800MPa) 300M steel at R=0.05. Work by Moss (6) [Moss, C.M., "Near-Threshold Fatigue Crack Propagation in Pressure Vessel Steel", S.M. Thesis, Massachusetts Institute of Technology, Sept. 1979] on normalized 2 1/4 Cr - 1 Mo (SA387-2-22) low strength steel displayed a decrease in threshold ΔK_0 of 10% upon increasing yield strength from 290 MPa to 390 MPa. These tests were performed in moist air at a load ratio of 0.05. Suresh (53) [Suresh, S., Zamiski, G.F., and Ritchie, R.O., "Fatigue Crack Propagation Behavior of 2 1/4 Cr - 1 Mo Steels for Thick Wall Pressure Vessels", in The Application of 2 1/4 Cr - 1 Mo Steels for Thick Wall Pressure Vessels", ASTM STP, ASTM, 1980] tested the thick section, quenched and tempered SA542 class 3 steel of fully bainitic microstructure. These tests showed a decrease in threshold….Figure 8 is a plot of threshold ΔK_0 values versus material yield strength taken for a number of steel conditions. The general trend is a decrease inthreshold ΔK_0 with increasing strength. Data on 2 1/4 Cr - 1 Mo steels from work by Moss (6) and Suresh (53) were plotted along with the threshold ΔK_0 for SA542 class 2 steel in the as-received condition. These points are connected, and are seen to follow the general trend. An important factor in the dependency of near-threshold growth on material strength is microstructure (grain size, phase, etc.). As a general rule, martensitic steels tend to offer the least resistance to near-threshold growth. Bainitic steels display a higher resistance and ferritic/pearlitic steels exhibit the most resistance, of these structures, to near-threshold growth. As a generality, fatigue crack growth is insensitive to material strength except in the near-threshold regime. In the mid growth regime, raising the strength of steels by nearly an order of magnitude does not change growth rates by more than a factor of 2 or 3 (25) [Lindley, T.C., Richards, C.E. and Ritchie, R.O., Metallurgia and Metal Forming, Vol. 43, 1976, p.268]. This similarity in growth rates above 10^{-6} mm/cycle is consistent with the fact that the mid growth regime is often independent of microstructure. To summarize, this phase of the study showed a decrease in threshold ΔK_0 and an increase in near-threshold growth rates with a change in yield strength from 575 MPa to 769 MPa. Future testing on this material is needed to provide threshold ΔK_0 values for the range of tempering temperatures that may have applicability in service…."
24	Page 62: "…PLASTICITY INDUCED CRACK CLOSURE: A MODEL FOR LOAD RATIO EFFECTS… Cooke and Beevers (22) [Cooke, R.J., and Beevers, C.J., Engineering Fracture Mechanics, Vol. 5, 1973, p. 1061], and Masounave and Bailon (23) [Masounave, J.and Bailon, J.P., Scripta Metallurgica, Vol. 9, 1975, p.723] found that this effect of load ratio on threshold ΔK_0, before the critical R, occurred at a constant value of K_{max}. Ritchie (7) [Aronson, G.H. and Ritchie, R.O., Journal of Testing and Evaluation, Vol. 7, 1979] observed similar trends in ultra high strength 300M steel. Schmidt and Paris (13) [Schmidt, R.A., and Paris, P.C., "Progress in Flaw Growth and Fracture Toughness Testing", ASTM STP 536, 1973 p. 79] showed that above the critical R, the threshold ΔK_0 remains constant whereas K_{max} increases. A model that may explain this behavior of decreasing ΔK_0 for increasing load ratios up to a critical R value, followed by a constant ΔK_0 for further increases in R, is based on 'plasticity induced crack closure'. The phenomenon of crack closure was first experimentally detected by Elber (21) [Elber,W.,"Damage Tolerance in Aircraft Structures", ASTM STP 486, 1971, p. 230]…."
25	Page 67-71: "…OXIDE INDUCED CRACK CLOSURE: A MODEL FOR ENVIRONMENTAL EFFECTS …A model has been proposed (45, 51, 53, 55) that may explain these environmental effects and is based on the concept of 'oxide induced crack closure'. This form of crack closure is based on the observation of microscopic corrosion (oxide) bands on the fracture surface of tests conducted in moist air at low load ratios (28, 45, 55). Such corrosion zones were present in all low R, moist air tests of this study (fig. 30a). White (77) performed Auger measurements of these oxide layers, and the results are shown in figure 31 for a similar steel (SA542-3). Oxide thickness, which is plotted along with the fatigue crack growth rate, is shown to increase with decrease in growth rate, and obtains a maximum value at the threshold growth rate. The maximum oxide thickness corresponds to an increase of almost 30 times that of a naturally formed oxide layer on fresh metal surface, under the same environmental conditions. A mechanism for this enlarged oxide layer is described by fretting oxidation (51). Once fresh reactive surface is created at the crack tip it will readily oxidize, for tests in moist air. Plasticity induced crack closure, occurring at load ratios below the critical R, causes contact between the two fracture surfaces. The associated tangential friction between the fracture surfaces may lead to cracking of the naturally formed oxide layer. The result is to generate new zones of fresh surface, further oxidation, and a thickening of the oxide film. The reason that the oxide thickness increases with decreasing growth rate has to due with the increased time for fretting oxidation to occur. At high load ratios there is no plasticity induced crack closure. Therefore for tests in moist air, where there will exist a naturally formed oxide layer, there is no mechanism for increased oxidation.

	The significance of this oxide build up at near-threshold growth rates (for low R) is to increase crack closure. Contact of the two fracture surfaces will occur sooner, thereby increasing closure initiation, increasing $K_{closure}$, and therefore decreasing the effective ΔK_0. Purified hydrogen and helium tests show relatively no evidence of oxidation (fig. 30), therefore there would be no mechanism for increased closure by oxide buildup. The oxide induced crack closure model proposes that the large influence of hydrogen on the near-threshold regime (compared to moist air) may not be due to hydrogen enhancing growth, but rather to the moist air environment decreasing growth due to oxide buildup. This model seems to explain the almost identical behavior for tests at high load ratio in air, hydrogen and helium, where there is no crack closure mechanism in operation except closure from reducing the loads to threshold ΔK_0…" [References in this section: "… 28. Ritchie, R.O., "Near-Threshold Fatigue Crack Propagation in Steels", MIT Fatigue and Plasticity Laboratory. 45. Ritchie, R.O., Suresh, S. and Toplosky, J., "Influences of Gaseous Environment on Low Growth-Rate Fatigue Crack Propagation in Steels", Annual Report No. 1 for Doe, Jan. 1980. 51. Stewart, A.T., Eng. Fract. Mech., 1980. 53. Suresh, S., Zamiski, G.F., and Ritchie, R.O., "Fatigue Crack Propagation Behavior of 2 1/4 Cr - 1 Mo Steels for Thick Wall Pressure Vessels", in The Application of 2 1/4 Cr - 1 Mo Steels for Thick Wall Pressure Vessels", ASTM STP, ASTM, 1980. 55. Ritchie, R.O., Moss, C.M., and Suresh, S., Journal of Engineering Materials and Technology, Trans. of ASME, Series H, Vol. 102, 1980. 77. White, C., "Oxide-Induced Crack Closure of Near-Threshold Fatigue Cracks", S.B. thesis, M.I.T., May 1980…"
#	**Doctoral thesis: *Fuquen-Molano 1982***
26	Pages 24-25: "…The threshold dependence on R has been rationalized in terms of closure effects in the wake of the crack tip. Closure of a crack at positive load occurs due to the permenent deformation imposed on the material before rupture (21) [W. Elber, American Society for Testing and Materials, STP 486, 1971, p. 230.]. This permanent deformation in the wake of the crack allows contact of the fracture surface before complete un- loading. Closure then affects the minimum stress intensity at the crack tip; therefore, the stress intensity range…calculated from externally applied loads could differ from the effective stress intensity range sensed at the crack tip (22) [R.A. Schmidt and P.C. Paris, American Society for Testing and Materials, STP 536, 1973, p. 79-94.]. The effects of crack closure and oxidizing environments could be very effectively coupled. Crack closure can lead to fretting of the contacting fracture surfaces which in the presence of aggressive environment causes accelerated oxidation; furthermore, the thickness of the reaction product enhances closure (23, 24) [23. R.O. Ritchie, in Fatigue thresholds, proc. 1st. Intl. conf., Stockholm, J. Backlund, A. Blam and C. J. Beevers, eds., EMAS Publ. Ltd. U.K. 1981.; 24. R.O. Ritchie, R. Fuquen-Molano, Annual Report No. 2 to Fossil Energy Division, D.O.E., Oct. 15, 1980. (MIT Fatigue and Plasticity Laboratory Report No. FPL/R/80/1035)]…"
27	Page 110: "… 4.5 DISCUSSION The results presented in this chapter are discussed in terms of the following main guidelines: a) The significance of testing for environmental study under high load ratio conditions; b) the water vapor effect on accelerating crack growth rates; c) the low R and high R results of moist - dry air…"
28	Page 117: "…The results of crack propagation at high load ratio showed that the presence of water vapor in the environment accelerates growth rates with respect to those characteristic of dehumidified air, helium or even gaseous hydrogen. The results show the aggressiveness of water vapor by reducing the fracture resistance and are consistent with reported results on Aluminum alloys…and AISI 4340 steel…. Detailed study of the role of the water vapor partial pressure on the growth rates has indicated the existence of a pressure range where the growth rates are pressure dependent…The partial pressure effects indicate that the transport of water vapor to the crack tip or availability of water molecules could be rate-limiting steps for the environmentally-enhanced crack growth process…"
29	Page 132: "…1 - The observed effects at high load ratio are independent of crack closure and therefore are true representation of the environmental contribution to crack growth. 2 - The observed behavior at low load ratio is affected by crack closure phenomena and the results are a combination of environment and closure effects. 3 - Crack closure is produced and enhanced by several factors such as: - the amount of plastic strain preceeding fracture or plasticity-induced crack closure - the presence of oxide product on the fracture surface or oxide-induced crack closure - the roughness of the fracture surface created by tortuous crack paths

	- the Mode II loading component becoming signifi- cant at low growth rates…"
30	Pages 135-136 "…4.6 CONCLUSIONS The near-threshold crack propagations in SA387 steel in water vapor containing environments produces a rough surface with cleavage-like facets indicating a reduction in ductility and an increased sensitivity to microstructure, Such features are not observed in dehumidified environments of air, oxygen, hydrogen and helium. The results lead to the conclusion that hydrogen from the water-metal reaction produces embrittlement of the metal and results in a distinctive rough fracture surface. The embrittlement reduces the fatigue resistance and it is observable through acceleration of the crack growth rates at high load ratio when crack closure is minimized. At low load ratio the roughness produced by the embrittlement in moist environments enhances closure through early contact of asperities. Fretting during closure enhances oxidation which at the same time increases the closure load. The effect of closure is to increase the discrepancy between effective and calculated stress intensities near-threshold; as a consequence at low load ratio moist environments pro- duce higher threshold than dehumidified environments. Analysis of some elementary reactions of the environmentmetal interaction leads to the conclusion that, at the experimental conditions of this work, the transport of environment in the crack channel corresponds to viscous flow; and that assuming fast hydrogen diffusion in the lattice, the possible rate-limiting steps are: the physical adsorption and the dissociation of the molecular species. Both processes are function of the partial pressure of the aggressive environment and are thermally activated. The faster crack propagation in moist environment than in gaseous molecular hydrogen leads to the conclusion that the rate-limiting steps may be different or at least have different activation energy, causing water vapor to be a better source of atomic hydrogen than molecular hydrogen at room temperature…"
31	Page 161-162 "…DISCUSSION The effect of water vapor at room temperature on the near-threshold crack propagation rates has been observed to have the following characteristics: 1 - It produces higher threshold than inert environment or vacuum at R = 0.05. 2 - It increases the growth rates compared to hydrogen gas and dehumidified air at R = 0.80. The low load ratio behavior has been interpreted using crack closure arguments and the oxide-induced crack closure model (70 [S. Suresh, G.F. Zaminski, and R.O. Ritchie, Metallurgical Transactions , vol. 12A, 1981.]). The high load ratio effect was not known with this material and leads to the mechanism of hydrogen em- brittlement in the presence of moist air proposed in Chapter 4. At low load ratio the moist air or water vapor con- taining environments give rise to two mechanisms of opposite effect on the crack growth rates: embrittlement by hydrogen from the dissociation reaction of water causes accelerated crack growth rates; crack closure enhanced by roughnessand oxidation of the fracture surface produces apparent lower growth rates and higher threhsold than inert environments. The first mechanism is experimentally supported by the results shown in Chapter 4 obtained at high load ratio where no closure effects are present. The moist air results at low load ratio (R = 0.05) presented in fig. 5.2 showed increasing growth rates with temperature indicating that the embrittlement process is thermally-activated and dominates the retarding effects of crack closure. The corrosion process is also thought to be thermally-activated which would make the oxide-induced crack closure appear thermally-activated; however this effect seems to be very small compared to crack accelerating contribution of hydrogen embrittlement…"
32	Page 171-172: "…5.6 CONCLUSIONS 1) At low load ratio the moist air or water vapor- containing environment gives rise to two mechanisms of opposite effects on the crack growth rates near-threshold: 1 - hydrogen embrittlement 2 - crack closure; both are thought to be thermally activated. The results showed increased growth rates with temperature, leading to the conclusion that at high temperatures hydrogen embrittle- dominates the retarding effect of crack closure, that is the activation energy of the embrittlement process is higher than that of oxide formation for the temperature range tested…"
#	**Lab report: *Ritchie et al. 1980b***
33	Page iii: "…ABSTRACT The influence of gaseous environment is examined on fatigue crackpropagation behavior in steels. Specifically, a fully martensitic 300-M ultrahigh strength steel and a fully bainitic 2(1/4)Cr-1Mo lower strength steel are investigated in environments of ambient temperature moist air and low pressure dehumidified hyqrogen and argon gases over a wide range of growth .rates from 10^{-8} to 10^{-2} mm/cycle, with particular emphasis given to behavior near the crack propagation threshold ΛK. It is found that two distinct· growth rate regimes exist where hydrogen can markedly accelerate crack propagation rates compared to air, i) at near-threshold levels below ($5xl0^{-6}$ mm/cycle) and ii) at higher growth rates, typically around

	l0^{-5} mm/cycle above a critical maximum stress intensity K^{T}_{max}. Hydrogen-assisted crack propagation at higher growth rates is attributed to a hydrogen embrittlement mechanism, with K^{T}_{max} nominally equal to K_{ISCC} (the sustained load stress corrosion threshold) in high strength steels, and far below K_{ISCC} in the strain-rate sensitive lower strength steels. Hydrogen-assisted crack propagation at near-threshold levels is attributed to.a new mechanism involving fretting-oxide-induced crack closure generated in moist (or oxygenated) environments. The absence of hydrogen embrittlement mechanisms at near-threshold levels is supported by tests showing that ΛK_0 values in dry gaseous argon are similar to ΛK_0 values in hydrogen. The.potential ramifications of these results are examined in detail…"
34	Page 5: "2.3 Accelerated K_{ISCC} Testing Thresholds for sustained-load stress corrosion cracking, K_{ISCC}, in gaseous hydrogen were estimated using the accelerated rising-load procedure of Clark and Landes… Standard… specimens…were loaded in air and 138kPa dry hydrogen gas at a fixed displacement rate corresponding to an initial elastic stress intensity rate ($K\cdot$) of 0.1 MPa√m/sec. K_{ISCC} values were estimated using J-integral measurements where the load/load-line displacement record in hydrogen showed significant departure from the base-line air record (Table II). The values quoted in Table II must only be taken as approximate because of the rapid $K\cdot$ rates utilized, and the approximate nature of the test procedure. We are currently repeating these measurements using an order of magnitude slower displacement rates…"
35	Page 13: "…It is tentatively suggested that the large acceieration due to gaseous hydrogen in low strength steels at low R ratios may not be entirely associated with hydrogen embrittlement *per se*, but instead involve a phenomenon which we term "fretting- oxide-induced" crack closure…" (emphasis in the original).
36	Page 9: "…Alloy steels with yield strengths below 1000 Mpa…are generally considered to be relatively immune to hydrogen embrittlement based on their high K_{ISCC} thresholds for sustained load crack-loading[20,31,32]. Under cyclic loading, however, recent data in this laboratory and elsewhere have shown that fatigue crack growth in these steels can be considerably enhanced due to the presence of gaseous hydrogen at stress intensities well below K_{ISCC}[20,31,32]…" (emphasis in the original. References are: "…20) R. 0. Ritchie: Annual Report No. 1 to Dept. of Energy, Fossil Energy Research, Sept. 1979, M.I.T. Fatigue and Plasticity Laboratory Report No. FPR/R/79/1027…31) R. L. Brazill, G. W. Simmons, and R. P. Wei: J. Eng. Matls. Tech., Trans. ASME Series H., vol. 101, 1979…32) S. Suresh, C. M. Moss, and R. 0. Ritchie: Proc. 2nd. Intl. Japan Inst. ·Metals Symp. on Hydrogen (JIMIS-2), Minakami Spa, Nov. 1979…")
37	Page 16 and 17: "…At first glance, the use of SA516 or X-65 low strength steels for such pipelines would suggest that there is no problem since such steels are considered to be relatively immune to gaseous hydrogen embrittlement, based on sustained load K_{ISCC} data. However, since hydrogen pipelines will contain in-line compressors, clearly cyclic loading will be present, and in view of the typical.hoop stresses and flaw sizes involved, conditions are likely to be in the near-threshold regime[43]. Although such data are presently being generated[43], it is probable that hydrogen will give rise to a marked enhancement in near-threshold crack velocities very similar to that observed in 2¼Cr-1Mo steel…" (underlined in the original). Reference 43 is: "…M. R. Mitchell, N. E. Paton, R. 0. Ritchie, and N. Q. Nguyen: Proc. Dept. of Energy Chemical Energy Storage and Hydrogen Entry Systems Contract Review, Reston, Virgina, Nov. 1974, p. 172.
38	Pages 18-19: "…6. PERSONNEL…The personnel involved in the program and their specific projects are listed below: a) Current personnel: i) Prof. R. 0. Ritchie, principal investigator ii) S. Suresh, research assistant iii) J. Toplosky, research assistant iv} H. Conley, undergraduate. b) Current projects: i) "Influence of Gaseous Environments on Fatigue Crack Propagation in a Bainitic 2~Cr-1Mo Pressure Vessei Steel" S. Suresh, Ph.D. thesis, expected 1981. ii) "Hydrogen-Assisted F~tigue Crack Propagation in Ultrahigh Strength 300-M Steel", J. Toplosky, S.M. thesis, expected 1980. iii) Relationship between Hydrogen-Assisted Cracking under Sustained and Cyclic Loads in Ultrahigh Strength.Steel", H. Conley, S.B. thesis, January 1980…" (*sic*)
39	Page ii: "…FOREWORD This report summarizes work performed during the initial year of the program, commencing May 1, 1979. The research was administered under contract No. DE-AC02-79ER10389.AOOO by the Office of Basic Energy Sciences, U.S. Department of Energy,- with Dr. Stanley M. Wolf as Program Monitor. The work was performed under the direction of

	Professor Robert 0. Ritchie as principal investigator, with assistance from graduate students S. Suresh and J. Toplosky, and undergraduate Helen Conley…”

Table 2. Plagiarism and duplication of the article *Wu et al. 2018* from *Li et al. 2015* and *Ding et al. 2014*			
ARTICLE	***Li et al. 2015*** ***Acoustic separation of circulating tumor cells***	***Wu et al. 2018*** ***Circulating Tumor Cell Phenotyping via High-Throughput Acoustic Separation***	***Ding et al. 2014*** ***Cell separation using tilted-angle standing surface acoustic waves***
ABSTRACT AND RESULTS	"…To further elucidate the role of CTCs in cancer metastasis and prognosis, effective methods for isolating extremely rare tumor cells from peripheral blood must be developed. Acoustic-based methods, which are known to preserve the integrity, functionality, and viability of biological cells…"	"…In order to fully exploit and interpret the information provided by CTCs, the development of a platform is reported that integrates acoustics and microfluidics to isolate rare CTCs from peripheral blood in high throughput while preserving their structural, biological, and functional integrity…"	
	"…We first validated the capability of this device by success fully separating…a variety of cancer cells from cell culture lines from WBCs with a recovery rate better than 83%…"	"…Cancer cells are first isolated from leukocytes…achieving a recovery rate of at least 86%…	
	"…circulating tumor cells (CTCs) serve as a liquid biopsy target…CTCs during the course of chemotherapy treatment may be beneficial for guiding therapeutic decisions…"	"…CTCs can be used…in the context of "liquid biopsy"— to provide valuable guidance for cancer therapy…"	
	"…could provide new insights into the mostly elusive, yet deadly, process of cancer metastasis…"	"…reveal important information about tumor heterogeneity and genetic mutations that initiate cancer's metastatic and drug resistance mechanisms…"	
		"…A PDMS microfluidic channel is bonded to a piezo- electric substrate between a pair of interdigitated transducers (IDTs) …"	"…A polydimethylsiloxane (PDMS) microfluidic channel was bonded in between a pair of identical interdigital transducers (IDTs) coated on a piezoelectric substrate…"

RESU

	"…Demonstration of High-Throughput Separation of Cultured Cancer Cells from WBCs…for MCF-7 cells and for HeLa cells…"	"…Acoustic Separation of Cancer Cells from White Blood Cells…we used the separation devices to isolate PC-3, LnCaP, HeLa, and MCF-7 cancer cells…"	"…Separation of Cancer Cells from Human Healthy WBCs. As a crucial step in isolating and analyzing circulating tumor cells for cancer diagnosis, we used the taSSAW device to separate MCF-7 cancer cells from normal leukocytes (WBCs)…"
	"…Probing CTCs from Breast Cancer Patient Blood Samples…As a practical demonstration, we tested our taSSAW device with blood samples obtained from three patients with metastatic breast cancer…"	"…Acoustic Separation of CTCs from Blood Samples from Prostate Cancer Patients…After demonstrating cancer cell separation with blood samples that contained predetermined proportions of cancer cells from cultures, we performed CTC separation using blood samples that were collected from patients with prostate cancer…"	
	"…To investigate the impact of current separation conditions on cell integrity, we examined both short-term viability and long-term cell proliferation following acoustic separation…."	"…the method shown here for isolating CTCs has the potential for high-throughput isolation of viable CTCs sufficient for downstream molecular and phenotypic analyses…"	

ARTICLE	***Li et al. 2015*** ***Acoustic separation of circulating tumor cells***	***Wu et al. 2018*** ***Circulating Tumor Cell Phenotyping via High-Throughput Acoustic Separation***	***Ding et al. 2014*** ***Cell separation using tilted-angle standing surface acoustic waves***
DISCUSSION	"…In this work, we demonstrated taSSAW-based high-throughput cell separation…"	"…We have successfully developed and tested a high-throughput, acoustic-based CTC-separation device…"	"…We have developed a taSSAW-based, label-free, cell-separation device that can achieve relatively high separation efficiency…"
	"…In this work, RBCs were removed using an RBC lysis buffer to facilitate the separation process. The use of an RBC lysis buffer has also been used by other CTC separation methods and has shown no negative impact on cancer cells… However, the RBC lysis step added extra sample processing time and decreased the overall processing throughput. In future studies, it would be desirable to integrate an RBC-removal function into the same microfluidic chip…"	"…In this work, all the RBCs are removed using a RBC lysis buffer before the CTC isolation process. Other CTC isolation methods have also utilized RBC lysis buffers prior to CTC isolation and reported no significant damage to isolated cancer cells… However, the RBC lysis step requires extra sample processing time and may lead to considerable loss of cancer cells or WBCs, or may alter the properties of the CTCs. In this regard, it is desirable for future studies to integrate a RBC-removal func- tion into the same acoustic separation chip…"	
FIGURES	"…Fig. 1. Schematic illustration and image of the high-throughput taSSAW de- vice for cancer cell separation…"	"…Figure 1. Working principle and structure of the high-throughput acoustic CTC separation devices…"	"…Fig. 1. Schematic illustration of working principle and device structure…"
		"…Figure 3. Numerical simulation of the velocity distribution in the modified channel with a divider and its effectiveness at increasing separation effi- ciency…"	"…Fig. 3. Numerical simulation and experimental demonstration of particle- separation processes…"
	"…Fig. 4. Micrographs of the separation process with acoustic field ON and OFF…"	"…Figure 4. High-throughput acoustic separation of cancer cells from WBCs…"	
	Other Figures also identical in principal, differing in specific content (*e.g.* type of cell analysed).		
REFS	Total 20 references.	Of a total of 52 references, 7 are identical and one similar (*Hou et al. 2012 vs. Hou et al. 2011*) to the 20 references in *Li et al. 2015*.	
		Li et al. 2015 is NOT mentioned in References.	
	In-principal overlap in Supplementary Information content, notably Supplementary Figures.		

Table 3. Publications by Suresh and others			
1	***Ding et al. 2014*; Corresponding authors: Ming Dao, Subra Suresh, and Tony Jun Huang [*PNAS*]**		
	"…separating circulating tumor cells, and for label-free cell separation with potential applications in biological research, disease diagnostics, and clinical practice…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, PA 16802	[Cell culture and human blood samples]	National Institutes of Health (NIH) Director's New Innovator Award (1DP2OD007209-01)
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		The Pennsylvania State University Center for Nanoscale Science (Materials Research Science and Engineering Center) under Grant DMR-0820404
	Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN 46556		The Pennsylvania State University node of the National Science Foundation-funded National Nanotechnology Infrastructure Network
	Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		Z.P. and M.D. also acknowledge partial support from NIH Grant U01HL114476
	Cell and Developmental Biology Program, The Pennsylvania State University, University Park, PA 16802		
	Department of Biomedical Engineering and Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		
2	***Li et al. 2015*; Corresponding authors: Ming Dao, Subra Suresh, and Tony Jun Huang [*PNAS*]**		
	"…we demonstrate the development of an acoustic-based microfluidic device that is capable of high-throughput separation of CTCs from peripheral blood samples obtained from cancer patients. Our method uses tilted-angle standing surface acoustic waves…automated operation while offering the capability to isolate rare CTCs in a viable state…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, PA 16802	"…approved by The Pennsylvania State University Institutional Review Board…"	NIH Grants 1 R01 GM112048-01A1
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		NIH Grants 1 R01 1R33EB019785-01
	Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN 46556		National Science Foundation
	Division of Hematology/Oncology, Penn State Hershey Cancer Institute, Hershey, PA 17033		Penn State Center for Nanoscale Science (Materials Research Science and Engineering Center) under Grant DMR-0820404
	Department of Biomedical Engineering and Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		Z.P. and M.D. also acknowledge partial support from NIH Grant U01HL114476

3	***Wu et al. 2018*; Corresponding authors: Ming Dao and Tony Jun Huang [*Small*]**		
	"…developed and tested a high-throughput, acoustic-based CTC-separation device…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Mechanical Engineering and Material Science, Duke University, Durham, NC 27708, USA	"…Men with castration-resistant metastatic prostate cancer and widespread bone metastases were enrolled as part of an IRB-approved clinical protocol at Duke University under informed consent, and blood samples were collected for CTC isolation. All men were receiving radium-223 therapy as part of their standard therapy, and all had received prior hormonal therapies for metastatic prostate cancer. Details of the eligibility criteria are provided on clinicaltrials.gov under NCT02204943…"	The authors acknowledge support from the National Institutes of Health (grant no. R01 GM112048)
	Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, PA 16802, USA		The authors acknowledge support from the National Institutes of Health (grant no. R33 EB019785)
	Duke Cancer Institute and Departments of Medicine Surgery, and Pharmacology and Cancer Biology, Duke University Medical Center, Durham, NC 27710, USA		The authors acknowledge support from the National Institutes of Health (DCI P30 CA014236)
	Eugene Bennett Department of Chemistry, West Virginia University, Morgantown, WV 26506, USA		National Science Foundation (grant no. IIP-1534645), and the Duke Cancer Institute clinical trial shared resource
	Department of Pharmacology & Chemical Biology Magee, Women's Research Institute, UPMC Hillman Cancer Center, University of Pittsburgh, Pittsburgh, PA 15213, USA		Duke Cancer Institute clinical trial shared resource
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA		M.D. acknowledges support from the National Institutes of Health (R01 HD086325).
	Nanyang Technological University, 50 Nanyang Avenue, Main Campus, Singapore 639798,, Singapore		

4	***Chen et al. 2014*; Corresponding authors: Ming Dao, Subra Suresh, Peter R. Preiser, and Jianzhu Chen [*PNAS*]**		
	Human natural killer cells control *Plasmodium falciparum* infection in humanized mice.		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Interdisciplinary Research Group in Infectious Diseases, Singapore-MIT Alliance for Research and Technology, Singapore 138602	"…All studies involving mice were approved by the Institutional Animal Care and Use Committee of NUS and MIT…"	National Research Foundation Singapore through the Singapore–MIT Alliance for Research and Technology's Interdisciplinary Research Group in Infectious Disease Research Program
	Humanized Mouse Unit, Institute of Molecular and Cell Biology, Agency for Science, Technology and Research, Singapore 138673		
	School of Biological Sciences, Nanyang Technological University of Singapore, Singapore 637551	"…Humanized mice were constructed as follows: Newborn pups (within 48 h of birth) were irradiated with 100 cGy using a gamma radiation source and were injected intracardially with CD34+ cells from fetal liver (2 × 105 cells per recipient). Mice were analyzed for human leukocyte reconstitution at age 10–12 wk by staining for human CD45 and mouse CD45…"	
	Department of Pathology and Laboratory Medicine, KK Women's and Children's Hospital, Singapore 229899		
	Department of Obstetrics and Gynaecology, KK Women's and Children's Hospital, Singapore 229899		
	Duke-National University of Singapore Graduate Medical School, Singapore 169857		
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		
	Department of Biology, Massachusetts Institute of Technology, Cambridge, MA 02139		
	Koch Institute for Integrative Cancer Research Massachusetts Institute of Technology, Cambridge, MA 02139		
	Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		
	Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		

5	***Amaladoss et al. 2015*; Corresponding authors: Ming Dao and Peter R. Presiser [*PLOS ONE*]**		
	"…De Novo Generated Human Red Blood Cells in Humanized Mice Support *Plasmodium falciparum* Infection…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Infectious Diseases Interdisciplinary Research Group, Singapore-Massachusetts Institute of Technology Alliance for Research and Technology, Singapore, 138602, Singapore	"…All studies involving human HSC from cord blood and mice were approved by the institutional review board (IRB) and institutional animal care and use committee (IACUC) of the National University of Singapore. Studies involving mice were also approved by the committee on animal care (CAC) of the Massachusetts Institute of Technology…"	National Research Foundation Singapore through the Singapore-MIT Alliance for Research and Technology's Infectious Disease IRG research programme
	Humanised Mouse Unit, Institute of Molecular and Cell Biology, Agency for Science, Technology and Research, Singapore, 138673, Singapore		
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States of America		
	Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America	"…Reconstitution of human blood lineage cells was carried out as described previously [*Chen et al. 2009*]… Briefly, newborn NSG pups (less than 48 h old) were irradiated with 100 cGy using a Gamma radiation source and injected intracardially with CD34+ [hematopoeitic stem cells] from cord blood (1x105 cells/recipient)…"	
	Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America		
	The Koch Institute for Integrative Cancer Research and Department of Biology, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States of America		
	School of Biological Sciences, Nanyang Technological University, Singapore, 637551, Singapore		
	***Chandramohanadas et al. 2014*; Corresponding author: Peter R. Preiser [*Journal of Infectious Diseases*]**		

6	"...the discovery of a small molecule inhibitor, NIC, capable of inhibiting host invasion through interacting with a major invasion-related protein, merozoite surface protein-1 (MSP-1). This interaction was validated through computational, biochemical, and biophysical tools..."		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Interdisciplinary Research Group of Infectious Diseases, Singapore MIT Alliance for Research and Technology Centre (SMART)	"...Collection of blood for Plasmodium culture was verified and approved by the Institutional Review Board (IRB) of National University of Singapore (NUS) ..."	Singapore-MIT Alliance for Research and Technology (SMART) Centre funded by The National Research Foundation (NRF) for financial support.
	Singapore University of Technology and Design, 20 Dover Drive		R. C. was partially supported by the start-up research grant (SRG LSC 2013 049) from Singapore University of Technology and Design (SUTD).
	Department of Microbiology, Yong Loo Lin School of Medicine, National University of Singapore		M. D. and S. S. acknowledge partial support from the National Institutes of Health (NIH) grant R01HL094270.
	School of Biological Sciences, Nanyang Technological University, Singapore		
	Department of Biological Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts		
	Singapore Immunology Network (SIgN), Agency for Science, Technology and Research (A*STAR)		
	Shoklo Malaria Research Unit, Mae Sot, Thailand		
	Centre for Tropical Medicine, Nuffield Department of Clinical Medicine, Oxford University, United Kingdom		
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge		
	Department of Biomedical Engineering and Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh		
7	***Chandramohanadas et al. 2011*; Corresponding authors: Ming Dao and Peter R. Presiser [*PLOS ONE*]**		
	"...Treatment of late-stage iRBCs with E64d and EGTA-AM prevented rupture, resulted in no major RBC cytoskeletal reconfiguration but altered schizont morphology followed by dramatic re-distribution of three-dimensional refractive index (3D-RI) within the iRBC..."		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Singapore-MIT Alliance for Research and Technology Centre, Singapore, Singapore	"...The blood collection scheme was approved by the Institutional Review Board (IRB) of National University of Singapore (NUS)..."	[None]
	George R. Spectroscopy Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America		
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America		
	National University of Singapore, Singapore, Singapore		
	Nanyang Technological University, Singapore, Singapore		

8	***Fedosov et al. 2011b*; Corresponding author: George E. Karniadakis [*PLOS ONE*]**		
	"…simulate infected RBCs in malaria using a multiscale RBC model based on the dissipative particle dynamics method, coupling scales at the sub-cellular level with scales at the vessel size. Our objective is to conduct a full validation of the RBC model with a diverse set of experimental data, including temperature dependence, and to identify the limitations of this purely mechanistic model…the simulated mechanical responses of healthy RBCs and *Pf*-RBCs were found to be in excellent agreement with optical tweezers experiments…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Division of Applied Mathematics, Brown University, Providence, Rhode Island, United States of America	[Mathematical model]	National Institutes of Health (NIH) Grant R01HL094270
	Institute of Complex Systems and Institute for Advanced Simulation, Forschungszentrum Jülich, Jülich, Germany		George E. Karniadakis acknowledges support from the National Science Foundation (NSF) Grant CBET-0852948
	School of Engineering, Brown University, Providence, Rhode Island, United States of America		Subra Suresh acknowledges support from the Interdisciplinary Research Group on Infectious Diseases (ID), which is funded by the Singapore-Massachusetts Institute of Technology (MIT) Alliance for Research and Technology (SMART)
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America		Computations were performed at the NSF's National Institute for Computational Sciences at the University of Tennessee (NICS) facility and at Argonne's National Lab facility (INCITE program)
9	***Fedosov et al. 2011a*; *Corresponding author: George E. Karniadakis* [*PNAS*]**		
	"…The dynamics of *Pf*-parasitized RBCs is studied by three-dimensional mesoscopic simulations of flow in cylindrical capillaries in order to predict the flow resistance enhancement at different parasitemia levels…The modeled mechanical properties are in excellent agreement with optical tweezers experiments…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Division of Applied Mathematics, Brown University, Providence, RI 02912	[Mathematical model]	National Institutes of Health (NIH) Grant R01HL094270
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		G.E.K. acknowledges support from the National Science Foundation (NSF) Grant CBET-0852948
	Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich, Germany		S.S. acknowledges support from the Interdisciplinary Research Group on Infectious Diseases (ID), which is funded by the Singapore-Massachusetts Institute of Technology (MIT) Alliance for Research and Technology (SMART)
			Computations were performed at the NSF's National Institute for Computational Sciences at University of Tennessee (NICS) facility

10	***Zhang et al. 2015*; Corresponding authors: Sulin Zhang and Subra Suresh [*PNAS*]**		
	"…This model enables a systematic study of the effects of changes in the molecular structures on the shear elasticity of *Pf*-infected RBC membranes…The extracted shear modulus of the healthy RBC thus falls within the range of existing experimental data [*Mills et al. 2004*]…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, PA 16802	[Mathematical model]	Y.Z., C.J.H., and S.L.Z. acknowledge support by the National Science Foundation (NSF) under Grant CMMI-0754463
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		Y.Z., C.J.H., and S.L.Z. acknowledge support by the National Science Foundation (NSF) under Grant CBET- 1067523
	Department of Nuclear Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		J.L. and S.K. acknowledge support by NSF Grant CBET-1240696
	Department of Biochemistry and Molecular Biology, Bio21 Molecular Science and Biotechnology Institute, The University of Melbourne, Melbourne, VIC 3010, Australia		L.T. acknowledges support from the Australian Research Council
	Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		
	Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		
	Computational Biology Department, Carnegie Mellon University, Pittsburgh, PA 15213		
11	***Park et al. 2008*; Corresponding author: Subra Suresh [*PNAS*]**		
	Phase microscopy of malaria-infected blood cells.		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	G. R. Harrison Spectroscopy Laboratory	[Cell culture using human blood]	National Institutes of Health Grant P41-RR02594-18
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		National Institutes of Health Grant 1-R01- GM076689-01
	School of Engineering and Harvard-MIT Division of Health Science and Technology, Massachusetts Institute of Technology, Cambridge, MA 02139		National Science Foundation Grant DBI-0754339
			Interdisciplinary Research Group on Infectious Diseases, which is funded by the Singapore-MIT Alliance for Research and Technology Center
			Y.P. was supported by Cambridge Foundation Fellowship
			Y.P. was supported by Samsung Scholarship
			Y.P. was supported by Whitaker Health Science Fellowship
			M.D.-S. and G.L. were partially supported by Global Enterprise for MicroMechanics and Molecular Medicine (GEM4) postdoctoral fellowships

12	***Park et al. 2010b*; Corresponding author: YongKeun Park [*Journal of Biomedical Optics*]**		
	Phase microscopy of malaria-infected blood cells.		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Massachusetts Institute of Technology, G. R. Harrison Spectroscopy Laboratory, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139 bc de	[probably cell culture using human blood]	National Institutes of Health P41-RR02594-18 .
	Massachusetts Institute of Technology, Department of Materials Science and Engineering, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139		Park was supported by a Samsung Scholarship
	University of Illinois at Urbana-Champaign, Beckman Institute for Advanced Science and Technology, Department of Electrical and Computer Engineering, 405 North Mathews Avenue, Urbana, Illinois 61801		Diez-Silva and Suresh acknowledge support from the Interdisciplinary Research Group on Infectious Diseases, which is supported by the Singapore-MIT Alliance for Research and Technology
	Korea University, Department of Physics, Anam-dong Sungbuk-gu, Seoul, 136-701 Korea		Diez-Silva and Suresh acknowledge support from the Interdisciplinary Research Group on Infectious Diseases, which is supported by the National Institutes of Health 1R01HL094270-01A1
	Massachusetts Institute of Technology, School of Engineering, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139		
13	***Aingaran et al. 2012*; Corresponding authors: Ming Dao and Matthias Marti [*Cellular Microbiology*]**		
	"…we present a model, which suggests that mature but not immature gametocytes circulate in the peripheral blood for uptake in the mosquito blood meal and transmission to another human host thus ensuring long-term survival of the parasite…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Immunology and Infectious Diseases, Harvard School of Public Health, Boston, MA 02115, USA	[Cell culture using human blood]	NIH grants R01A107755801 (M.M.)
	Singapore-MIT Alliance, National University of Singapore, 4 Engineering Drive 3, Singapore 117576		R01HL094270 (Z.L.P., M.D.S., M.D., S.S.)
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA		Infectious Diseases Interdisciplinary Research Group of the Singapore MIT Alliance for Research and Technology (SMART) (Z.L.P., M.D.S., C.T.L., M.D., S.S.)
	Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany		Advanced Materials for Micro andNano Systems Programme of the Singapore-MIT Alliance (SMA) (R.Z., C.T.L., M.D., S.S.)
			(A.U.) gratefully acknowledges support by the Alexander von Humboldt- Foundation in form of a Feodor Lynen Research Fellowship

14	***Bow et al. 2011*; Corresponding author: Jongyoon Han [*Lab Chip*]**		
	"…A microfabricated deformability-based flow cytometer with application to malaria…"		
	Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 36-841, Cambridge, MA, 02139, USA	[Cell culture using human blood]	H. Bow, I. V. Pivkin, M. Diez-Silva, S. Suresh, and J. Han filed two US provisional patents based on a portion of the contents of this paper
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, USA		Interdisciplinary Research Groups on Infectious Diseases and BioSyM, which are funded by the Singapore-MITAlliance for Research and Technology (SMART) Center
	Department of Biological Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, USA		National Institutes of Health Grant R01 HL094270-01A1
			National Institutes of Health Grant 1-R01-GM076689-01
			We thank D. J. Quinn for background experimental work that was helpful in the initial calibrations of the DPD modeling
			All simulations were performed on the Cray XT5 (Kraken) at NICS
			S.J.G. was supported by NIEHS Training Grant 5-T32-ES007020
			MIT Startup Funds were used otherwise
15	***Carvalho et al. 2013*; Corresponding author: Ming Dao [*Acta Biomaterialia*]**		
	"…Quantitative details of cytoadherence influenced by molecular level mechanisms for P. falciparum iRBCs are presented under physiologically/pathologically relevant conditions. The results obtained here have established that the binding force of the CSA–PfEMP1 complex decreases significantly with exposure to febrile temperature…"		
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA	[Cell culture using human blood]	Infectious Diseases Interdisciplinary Research Group of the Singapore–MIT Alliance for Research and Technology (SMART).
	ICEMS, Instituto Superior Tecnico, University of Lisbon, Lisbon, 1049-001, Portugal		The visits of P.A.C. to MIT were supported by the Portuguese Foundation for Science and Technology, the MIT-Portugal program and the Fulbright Commission
	Department of Biostatistics, Harvard School of Public Health, Boston, MA 02115, USA		
16	***Cai et al. 2021*; Corresponding authors: Ming Dao, George Em Karniadakis, and Subra Suresh [*PNAS*]**		
	Device and model of blood flow.		
	Division of Applied Mathematics, Brown University, Providence, RI 02912	"…All procedures on peripheral blood specimens were approved and performed in accordance with the Singapore National Health Group Domain Specific Review Board (the central ethics committee) and mutually recognized by Nanyang Technological University Institutional Review Board (IRB#2018/00671). All blood specimens were de-identified prior to use in the experiment….	S.C. and G.E.K. were supported by Department of Energy Physics-Informed Learning Machines Project No. DE-SC0019453
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		H.L., M.D., and G.E.K. were supported by NIH Grant R01HL154150
	School of Biological Sciences, Nanyang Technological University, 639798 Singapore		M.D. was supported by the Massachusetts Institute of Technology J-Clinic for Machine Learning and Health
	School of Engineering, Brown University, Providence, RI 02912		F.K. and S.S. were supported by Nanyang Technological University, Singapore, through the Distinguished University Professorship (S.S.).
	Nanyang Technological University, 639798 Singapore		

17	***Qiang et al. 2019*; Corresponding authors: Ming Dao, Subra Suresh, and E. Du (the latter is probably Sarah E. Du) [*PNAS*]**		
	"…Mechanical fatigue of human red blood cells…"		
	Department of Ocean and Mechanical Engineering, Florida Atlantic University, Boca Raton, FL 33431	"…Blood samples from healthy donors were obtained with institutional review board (IRB) approval from Florida Atlantic University. All blood samples used were de-identified prior to use in the study…"	National Science Foundation Grant 1635312
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		National Science Foundation Grant 1464102
	Nanyang Technological University, Republic of Singapore 639798Nanyang Technological University, Republic of Singapore 639798		M.D. acknowledges support from NIH Grant U01HL114476
	Department of Biological Sciences, Florida Atlantic University, Boca Raton, FL 33431		S.S. acknowledges Nanyang Technological University, Singapore, for support through the Distinguished University Professorship
18	***Li et al. 2018*; Corresponding authors: Ming Dao, George E. Karniadakis, and Subra Suresh [*PNAS*]**		
	"…Mechanics of diseased red blood cells in human spleen and consequences for hereditary blood disorders…"		
	Division of Applied Mathematics, Brown University, Providence, RI02912	[Mathematical model]	National Institutes of Health Grants U01HL114476
	Faculte ´de Médecine Université Paris Descartes, Institut National de la Transfusion Sanguine, Paris 75015, France		National Institutes of Health Grant U01HL116323
	Laboratory of Excellence GR-Ex "The Red Blood Cell: From Genesis to Death", SorbonneParisCite´, 75015 Paris, France		This research used resources of the Argonne Leadership Computing Facility under Contract DE-AC02-06CH11357
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139		resources of the Oak Ridge Leadership Computing Facility under Contract DE-AC05- 00OR22725
	Nanyang Technological University, 639798, Singapore		S.S. acknowledges support from the Distinguished University Professorship at Nanyang Technological University.
19	***Li et al. 2017*; Corresponding authors: Ming Dao and George E. Karniadakis [*PLOS Computational Biology*]**		
	Sickle cell anemia biophysics.		
	Division of Applied Mathematics, Brown University, Providence, Rhode Island, United States of America	"…following institutional review board (IRB) approvals from the National Institutes of Health (NIH) and Massachusetts Institute of Technology (MIT)…"	An award of computer time was provided by the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America		This research used resources of the Argonne Leadership Computing Facility, which is a DOE Office of Science User Facility supported under Contract DE-AC02- 06CH11357
	Department of Ocean and Mechanical Engineering, Florida Atlantic University, Boca Raton, Florida, United States of America		Part of this research was conducted using computational resources and services at the Center for Computation and Visualization (CCV), Brown University
	Department of Biomedical Engineering, Computational Biology Department, and Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania, United States of America		

20	***Peng et al. 2013*; Corresponding author: Subra Suresh [*PNAS*]**		
	Malaria infected red blood cells model and experiments (Quinn).		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139	[Mathematical model]	National Institutes of Health Grant R01HL094270
	Division of Applied Mathematics, Brown University, Providence, RI 02912		New Department of Energy Collaboratory on Mathematics for Mesoscopic Modeling of Materials (CM4)
	Institute of Computational Science, Faculty of Informatics, University of Lugano, 6904 Lugano, Switzerland		I.V.P. acknowledges support from the Swiss National Science Foundation
	Swiss Institute of Bioinformatics, 1015 Lausanne, Switzerland		Z.P., M.D., and S.S. acknowledge partial support from the Singapore–Massachusetts Institute of Technology Alliance for Research and Technology (SMART) Center as well as Singapore MIT Alliance (SMA)
	Department of Materials Science and Engineering and Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213		Simulations were carried out at the Argonne Leadership Computing Facility through the Innovative and Novel Computational Impact on Theory and Experiment program at Argonne National Laboratory and also at the Swiss National Supercomputer Center under projects s311 and s340.
21	***Papageorgiou et al. 2018*; Corresponding authors: Subra Suresh and Ming Dao [*PNAS*]**		
	"…Simultaneous polymerization and adhesion under hypoxia in sickle cell disease…"		
	Affiliations on paper; Suresh affiliation(s) in grey	**Ethics approval if any**	**Funding**
	Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139	"…Blood samples were drawn from homozygous SS SCD pa- tients at the University of Pittsburgh (Pittsburgh) (University of Pittsburgh IRB protocol PRO08110422) and the Massachusetts General Hospital (Boston) under a protocol of Excess Human Materials approved by the Partners Healthcare IRB with a waiver of consent…"	G.E.K. acknowledges support from the computing resources at Argonne National Laboratory/Oakridge
	Division of Applied Mathematics, Brown University, Providence, RI 02912		S.S. acknowledges support from Nanyang Technological University through the Distinguished University Professorship
	Department of Medicine, Heart, Lung, Blood and Vascular Medicine Institute, University of Pittsburgh School of Medicine, Pittsburgh, PA 15261		We acknowledge support from NIH Grants U01HL114476 and R01HL121386
	Division of Hematology–Oncology, Department of Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA 15261		
	Nanyang Technological University, Singapore 639798		

Table 4. Suresh reported funding, sample analysis[18]									
#	**Grant number as mentioned in an article**	**Total funding to date**	**Award active date**	**Title of grant**	**Contact Principal Investigator/ Project leader**	**Awardee organization**	**Article(s) mentioning grant; and [person acknowledging the grant if any]**	**Number of additional funding sources in article**	**Article content related to grant**
National Institutes of Health (NIH) grants									
1	1DP2OD007209-01	$2,211,000	2010-2015	On-Chip Optofluidic Laser Scanning Confocal Microscope for Early Cancer Detection	Tony Jun Huang	Pennsylvania State University-Univ Park	*Ding et al. 2014*	3	Yes
2	U01HL114476	$3 897 672	2013-2019	Multiscale Modeling of Sickle Cell Anemia: Methods and Validation	George Karniadakis	Brown University	*Ding et al. 2014* [Zhangli Peng (not listed in grant); and Ming Dao (*Other PI*)]	3	No
							Li et al. 2015 [Zhangli Peng (not listed in grant); and Ming Dao (*Other PI*)]	4	No
							Li et al. 2018	4	Yes
							Qiang et al. 2019 [Ming Dao (*Other PI*)]	3	?
3	1 R01 GM112048-01A1	$1 145 572	2014-2018	Standing Surface Acoustic Wave Based Cell Sorters for Maintaining Cell Integrity	Tony Jun Huang	Pennsylvania State University-Univ Park And Duke University	*Li et al. 2015*	4	Yes
							Wu et al. 2018	5	Yes
4	1 R01 1R33EB019785-01 [search for: 1R33EB019785-01]	$1 074 634	2014-2018	Validation of acoustic tweezers for single-cell analyses of purine metabolism	Tony Jun Huang	Pennsylvania State University-Univ Park	*Li et al. 2015*	4	No
							Wu et al. 2018	5	?
5	R01 HD086325	$3 572 467	2015-2021	Extracellular vesicles and their ncRNA cargo as markers of trophoblast injury	Yoel Sadovsky	Magee-Women's Research Institute and Foundation	*Wu et al. 2018* [Ming Dao, not listed as *Other* or *co-PI*)	5	No

[18] Links to webpages of the grants are in Table 5. below. 'Article content' in this Table refers to the scientific content of the article and whether it is related to the declared grant objective(s). Please note the sample analyzed here is far from exhaustive.

#	Grant number as mentioned in an article	Total funding to date	Award active date	Title of grant	Contact Principal Investigator/ Project leader	Awardee organization	Article(s) mentioning grant; and [person acknowleding the grant if any]	Number of additional funding sources in article	Article content related to grant
National Institutes of Health (NIH) grants									
6	R01HL094270	$1 781 761	2009-2013	Multiscale Modeling and Parallel Simulations of Blood Flow in Cerebral Malaria an	George Karniadakis	Brown University	*Chandramohanadas et al. 2014* [Ming Dao (not listed); and Subra Suresh (*Other PI*)]	2	?
							Fedosov et al. 2011b	3	Yes
							Fedosov et al. 2011a	3	Yes
							Park et al. 2010b [Monica Diez-Silva and Subra Suresh]	3	?
							Aingaran et al. 2012 [Zhangli Peng, Monica Diez-Silva, Ming Dao, and Subra Suresh]	4	Yes ?
							Peng et al. 2013	4	Yes ?
7	R01- GM076689-01	$871 494	2005-2007	MSM-Multi-scale Analysis of Cellular Force Transmission and Biochemical Activatio	Roger D. Kamm	Massachusetts Institute of Technology	*Park et al. 2008*	7	No
							Bow et al. 2011	7	?
8	R01HL154150	$705 243	2020-2021	Multifidelity and multiscale modeling of the spleen function in sickle cell disease with in vitro, ex vivo and in vivo validations	George Karniadakis	Brown University	*Cai et al. 2021* [He Li, Ming Dao, and George Karniadakis]	3	?
9	U01HL116323	$2 400 166	2013-2019	Multiscale, Multiphysics Model of Thrombus Biomechanics in Aortic Dissection	Jay D. Humphrey	Yale University	*Li et al. 2018*	4	No
10	R01A107755801	No info	No info	No info	No info	No info	*Aingaran et al. 2012* [Matthias Marti]	4	No info
11	P41-RR02594-18	No info	No info	No info	No info	No info	*Park et al. 2008*	7	No info
							Park et al. 2010b	3	
12	DCI P30 CA014236 [P30 CA014236]	This appears to be a research support or core grant to various individuals at Duke University and since 1985. The grant cannot be specified as cited, see https://reporter.nih.gov/search/x6_IXA1hE0eJnPJlw_6bnA/projects. Mentioned in *Wu et al. 2018*. Furthermore, after the NSF IIP-1534645, it states "...and the Duke Cancer Institute clinical trial shared resource..." as well as "...Duke Cancer Institute clinical trial shared resource..."??							

#	Grant number as mentioned in an article	Total funding to date	Award active date	Title of grant	Contact Principal Investigator/ Project leader	Awardee organization	Article(s) mentioning grant; and [person acknowleding the grant if any]	Number of additional funding sources in article	Article content related to grant
National Science Foundation (NSF) grants									
13	IIP-1534645	$899 999	2015-2017/8	STTR Phase II: Development of Bio-compatible and Bio-safe Cell Sorters	Lin Wang [Tony Jun Huang (Co-Principal Investigator)]	Ascent Bio-Nano Technologies, Inc	*Wu et al. 2018*	5	Yes
14	CBET-0852948	$356 671	2009-2013	Multiscale Modeling of Flow over Functionalized Surfaces: Algorithms and Applications	George Karniadakis	Brown University	*Fedosov et al. 2011b* *Fedosov et al. 2011a* [George Karniadakis]	3 3	Yes Yes
15	CBET- 1067523	$204 000	2011-2015	Collaborative Research: Developing A Complete Membrane-Cytoskeleton Model for Human Erythrocyte	Sulin Zhang	Pennsylvania State University	*Zhang et al. 2015* [Yao Zhang, Changjin Huang, and Sulin Zhang]	3	Yes
16	1635312	$399 749	2016-2020	Dynamic and Fatigue Analysis of Healthy and Diseased Red Blood Cells	E Du	Florida Atlantic University	*Qiang et al. 2019*	3	Yes
17	1464102	$166 935	2015-2018	CRII: SCH: A Smart Biosensor for Monitoring Cell Sickling in Patients with Sickle Cell Disease	E Du	Florida Atlantic University	*Qiang et al. 2019*	3	?
18	CMMI-0754463 (Div Civil, Mechanical and Manufacturing Innovation)	No info	No info	No info	No info	No info	*Zhang et al. 2015* [Yao Zhang, Changjin Huang, and Sulin Zhang]	3	No info
19	CBET-1240696	No info	No info	No info	No info	No info	*Zhang et al. 2015* [Ju Li and Sangtae Kim]	3	
20	DBI-0754339	No info	No info	No info	No info	No info	*Park et al. 2008*		

#	Grant number as mentioned in an article	Total funding to date	Award active date	Title of grant	Contact Principal Investigator/ Project leader	Awardee organization	Article(s) mentioning grant; and [person acknowleding the grant if any]	Number of additional funding sources in article	Article content related to grant
Grants related to Singapore									
21	National Research Foundation Singapore through the Singapore–MIT Alliance for Research and Technology's Interdisciplinary Research Group in Infectious Disease Research Program	No info	No info	No info	No info	No info	*Chen et al. 2014*	0	No info
							Amaladoss et al. 2015	0	
							Chandramohanadas et al. 2014	2	
							Fedosov et al. 2011b [Subra Suresh]	3	
							Fedosov et al. 2011a [Subra Suresh]	3	
							Park et al. 2008	7	
							Park et al. 2010b [Monica Diez-Silva and Subra Suresh]	3	
							Aingaran et al. 2012 [Zhangli Peng, Monica Diez-Silva, Chwee Teck Lim, Ming Dao, and Subra Suresh]	4	
							Bow et al. 2011	6	
							Carvalho et al. 2013	1	
							Peng et al. 2013 [Zhangli Peng, Ming Dao, and Subra Suresh]	4	
22	Distinguished University Professorship (Nanyang Technological University)	No info	No info	No info	No info	No info	*Cai et al. 2021* [Fang Kong and Subra Suresh]	3	No info
							Qiang et al. 2019 [Subra Suresh]	3	
							Li et al. 2018 [Subra Suresh]	4	
							Papageorgiou et al. 2018 [Subra Suresh]	2	

Table 5. Links to grants in Table 4.		
# from Table 4.	**Grant number as mentioned in an article**	**Link**
1	1DP2OD007209-01	https://reporter.nih.gov/search/T4uqz0VezkaK9NbGztST1w/project-details/7982030
2	U01HL114476	https://reporter.nih.gov/search/ki5ojysVSkiU9DuScH2-oQ/project-details/9315872
3	1 R01 GM112048-01A1	https://reporter.nih.gov/search/wIVKoIkY_US6KEWyqXsjtw/project-details/8901247
4	1 R01 1R33EB019785-01 [search for 1R33EB019785-01]	https://reporter.nih.gov/search/1W0EoJPqo02h81locZ1nYw/project-details/9090085
5	R01 HD086325	https://reporter.nih.gov/search/NwkH-YW6nEWYkB0HeUoUzw/project-details/9701262
6	R01HL094270	https://reporter.nih.gov/search/geUpp0cvAUOTuNkl_hrvTQ/project-details/8065374
7	R01- GM076689-01	https://reporter.nih.gov/search/qa-EnwY9tUGLGMUDmtQOUw/project-details/7032555
8	R01HL154150	https://reporter.nih.gov/search/JIj-lnKqTEy1V2taAb1jTg/project-details/10052044
9	U01HL116323	https://reporter.nih.gov/search/wojQ9jg1rEqOqtlaGRa9ZQ/project-details/9282636
13	IIP-1534645	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1534645&HistoricalAwards=false
14	CBET-0852948	https://www.nsf.gov/awardsearch/showAward?AWD_ID=0852948
15	CBET- 1067523	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1067523
16	1635312	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1635312
17	1464102	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1464102

Table 6. Patent applications by Suresh and others					
#	**Patent ID — date of application**	**Patent title**	**Inventors**	**Applicant**	**Outcome**
1	US2017232439 (A1) — 2017-08-17	SEPARATION OF LOW-ABUNDANCE CELLS FROM FLUID USING SURFACE ACOUSTIC WAVES	SURESH SUBRA [US]; LI PENG [US]; DAO MING [US]; CHEN YUCHAO [US]; DING XIAOYUN [US]; HUANG TONY JUN [US]; PENG ZHANGLI [US]	UNIV CARNEGIE MELLON [US]; MASSACHUSETTS INST TECHNOLOGY [US]; PENN STATE RES FOUND [US]	08.07.2019: Abandonment
2	WO2016025518 (A1) — 2016-02-18	SEPARATION OF LOW-ABUNDANCE CELLS FROM FLUID USING SURFACE ACOUSTIC WAVES	SURESH SUBRA [US]; LI PENG [US]; DAO MING [US]; CHEN YUCHAO [US]; DING XIAOYUN [US]; HUANG TONY JUN [US]; PENG ZHANGLI [US]	CARNEGIE MELLON UNIVERSITY, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ; THE PENN STATE RESEARCH FOUNDATION	14.02.2017: "...Lack of unity of invention...The phrase "segmented interdigital transducer" (S-IDT) does not appear to have an established meaning in the art...this phrase has been given the meaning provided on page...That is, an S-IDT has been construed as an IDT..." The application is deemed to be withdrawn, Status updated on 04.08.2017, Database last updated on 24.05.2021
3	WO2017127686 (A1) — 2017-07-27	THREE-DIMENSIONAL ACOUSTIC MANIPULATION OF CELLS	SURESH SUBRA [US]; GUO FENG [US]; MAO ZHANGMING [US]; DAO MING [US]; HUANG TONY JUN [US]	(CARNEGIE MELLON UNIVERSITY, ; THE PENN STATE RESEARCH FOUNDATION, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY)	24.07.2018: Non-establishment of priority with regard to novelty, inventive step and industrial applicability; Lack of unity of invention; "...It would have been obvious to one of ordinary skill in the art at the time of invention to modify Penn State with the teaching of Hunt for the purpose of detecting a target substances in cell cultures..." The application is deemed to be withdrawn, Status updated on 15.03.2019, Database last updated on 24.05.2021
4	US2019031999 (A1) — 2019-01-31	THREE-DIMENSIONAL ACOUSTIC MANIPULATION OF CELLS	SURESH SUBRA [US]; GUO FENG [US]; MAO ZHANGMING [US]; DAO MING [US]; HUANG TONY JUN [US]	UNIV CARNEGIE MELLON [US]; PENN STATE RES FOUND [US]; MASSACHUSETTS INST TECHNOLOGY [US]	2018-09-07: Assigned to THE PENN STATE RESEARCH FOUNDATION; 2018-12-17: Assigned to NATIONAL INSTITUTES OF HEALTH (NIH), U.S. DEPT. OF HEALTH AND HUMAN SERVICES (DHHS), U.S. GOVERNMENT; 2019-01-31: Publication of US20190031999A1 2019-04-25: Assigned to MASSACHUSETTS INSTITUTE OF TECHNOLOGY; 26.02.2020: "...This is a decision on the request for correction of patent application under...The request is DISMISSED...Applicant requests that the application be republished because the patent application publication contains an allegedly material error on the front page of the publication wherein the Inventor information is incorrect...A material mistake must affect the public's ability to appreciate the technical diclosure of the patent application publication...Inventor information is incorrect is not a material error..."; 13.11.2020: List of references cited by examiner, Requirement for Restriction/Election

5	US9134294 (B2) — 2015-09-15 Application US12/927,031 Application US12/927,031	Method and apparatus for high throughput diagnosis of diseased cells with microchannel devices	MANALIS SCOTT [US]; BURG THOMAS [DE]; SURESH SUBRA [US]; BABCOCK KEN [US]	MANALIS SCOTT, ; BURG THOMAS, ; SURESH SUBRA, ; BABCOCK KEN, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY	2015-09-15: Application granted; Status Active; 2028-03-15: Adjusted expiration
6	US2011124095 (A1) — 2011-05-26 Application US12/927,031	Method and apparatus for high throughput diagnosis of diseased cells with microchannel devices	MANALIS SCOTT [US]; BURG THOMAS [DE]; SURESH SUBRA [US]; BABCOCK KEN [US]	MANALIS SCOTT, ; BURG THOMAS, ; SURESH SUBRA, ; BABCOCK KEN, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY	06.10.2014: Non-Final Rejection 26.08.2015: Issue Notification "...The Patent Term Adjustment is 435 days(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page..." 27.02.2019: "Statement claiming small entity status [MIT]
7	US2009053749 (A1) — 2009-02-26 US11/620,230	Method and Apparatus for High Throughput Diagnosis of Diseased Cells With Microchannel Devices	MANALIS SCOTT [US]; BURG THOMAS [US]; SURESH SUBRA [US]; BABCOCK KEN [US]	MASSACHUSETTS INST TECHNOLOGY [US]	19.01.2011: Abandonment
8	WO2007081902 (A3) — 2008-10-09	METHOD AND APPARATUS FOR HIGH THROUGHPUT DIAGNOSIS OF DISEASED CELLS WITH MICROCHANNEL DEVICES	MANALIS SCOTT [US]; SURESH SUBRA [US]; BURG THOMAS [US]; BABCOCK KEN [US]	MASSACHUSETTS INST TECHNOLOGY [US]; MANALIS SCOTT [US]; SURESH SUBRA [US]; BURG THOMAS [US]; BABCOCK KEN [US]	Status Abandoned; 02.09.2008: International Preliminary Report on Patentability Chapter I "Lack of unity of invention" The application is deemed to be withdrawn, Status updated on 16.01.2009, Database last updated on 24.05.2021
9	US2018267021 (A1) — 2018-09-20	METHODS AND DEVICES FOR ASSESSING CELL PROPERTIES UNDER CONTROLLED GAS	SURESH SUBRA [US]; DU E [US]; DIEZ SILVA MONICA [US]; DAO MING [US]	UNIV CARNEGIE MELLON [US]; MASSACHUSETTS INST TECHNOLOGY [US]	02.11.2020: Abandonment

		ENVIRONMENTS			
10	WO2016090264 (A1) — 2016-06-09	METHODS AND DEVICES FOR ASSESSING CELL PROPERTIES UNDER CONTROLLED GAS ENVIRONMENTS	SURESH SUBRA [US]; DU E [US]; DIEZ SILVA MONICA [US]; DAO MING [US]	CARNEGIE MELLON UNIVERSITY, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY	06.06.2017: "...Claims...do not meet the requirements...with regard to novelty...claims...do not involve an inventive step... The application is deemed to be withdrawn, Status updated on 24.11.2017, Database last updated on 24.05.2021
11	WO2017210494 (A1) — 2017-12-07	MICROFLUIDIC-BASED MULTIPLEX CELL ASSAY FOR DRUG COMPOUND TESTING	ABIDI SABIA [US]; PAPAGEORGIOU DIMITRIOS P [US]; DAO MING [US]; SURESH SUBRA [US]	CARNEGIE MELLON UNIVERSITY, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY	04.12.2018: "...Non-establishment of opinion with regard to novelty, inventive step and insdustrial applicability
12	US2011293558 (A1) — 2011-12-01	MATERIAL PROPERTIES OF T CELLS AND RELATED METHODS AND COMPOSITIONS	SURESH SUBRA [US]; CHEN JIANZHU [US]; CHANG IRENE YIN-TING [CN]	SURESH SUBRA, ; CHEN JIANZHU, ; CHANG IRENE YIN-TING, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY	18.07.2013: Abandonment
13	WO2019117814 (A1) — 2019-06-20	DIRECTED POLYMERIZATION METHOD TO GENERATE COMPLEX, THREE DIMENSIONAL (3D) STRUCTURES IN SOFT MATERIALS	HSIA KUEN JIMMY [US]; HUANG CHANGJIN [US]; SURESH SUBRA [SG]	NANYANG TECHNOLOGICAL UNIVERSITY, ; CARNEGIE MELLON UNIVERSITY	16.06.2020: "...Claims...are not novel and therefore do not comply with PCT...Claims...do not involve an inventive step...In view that features does not contribute to any other expected advantages, claims...are not considered to possess any inventiveness..." 20.06.2019: Priority Document
14	CN111788058 (A) — 2020-10-16	DIRECTED POLYMERIZATION METHOD TO GENERATE COMPLEX, THREE DIMENSIONAL (3D) STRUCTURES IN	HSIA KUEN JIMMY; HUANG CHANGJIN; SURESH SUBRA	UNIV NANYANG TECH; UNIV CARNEGIE MELLON	2020-10-16 Publication of CN111788058A; Status Pending

		SOFT MATERIALS			
15	WO2020076519 (A1) — 2020-04-16	ELASTIC STRAIN ENGINEERING OF DEFECT DOPED MATERIALS	DAO MING [US]; LI JU [US]; SHI ZHE [US]; SURESH SUBRA [US]	MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ; NANYANG TECHNOLOGICAL UNIVERSITY	13.04.2021: "...Claims...lack novelty...inventive step...lacking clarity..."
16	WO2020076181 (A1) — 2020-04-16	ELASTIC STRAIN ENGINEERING OF MATERIALS	DAO MING [US]; LI JU [US]; SHI ZHE [US]; TSYMBALOV EVGENII ALEKSEEVICH [RU]; SHAPEEV ALEXANDER VASILIEVICH [RU]; SURESH SUBRA [SG]	MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ; SKOLKOVO INSTITUTE OF SCIENCE AND TECHNOLOGY, ; NANYANG TECHNOLOGICAL UNIVERSITY, ; DAO, Ming, ; LI, Ju, ; SHI, Zhe, ; TSYMBALOV, Evgenii Alekseevich, ; SHAPEEV, Alexander Vasilievich, ; SURESH, Subra	13.04.2021: "...Non-establishment of opinion with regard to novelty, inventive step and insdustrial applicability...Lack of unity of invention..." 07.05.2020: Rule 92BIS Change (address)
17	WO2020263358 (A1) — 2020-12-30	MACHINE LEARNING TECHNIQUES FOR ESTIMATING MECHANICAL PROPERTIES OF MATERIALS	LU LU [US]; DAO MING [US]; SURESH SUBRA [SG]; KARNIADAKIS GEORGE E [US]	NANYANG TECHNOLOGICAL UNIVERSITY, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY, ; BROWN UNIVERSITY	30.12.2020: "...Claims...lack an inventive step...This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional dees must be paid...""" 11.02.2021: NTU address found to be incorrect, Published International Application
18	JP2006189454 (A) — 2006-07-20	REAL-TIME EVALUATION OF STRESS FIELD AND CHARACTERISTIC IN LINE STRUCTURE FORMED ON SUBSTRATE	SURESH SUBRA; ROSAKIS ARES J	CALIFORNIA INST OF TECHNOLOGY	18.10.2011: Decision of Refusal
19	6,924,497 10/630,512 Filed: July 29, 2003	Systems for measuring stresses in line features formed on substrates	Suresh; Subra (Wellesley, MA), Rosakis; Ares J. (Altadena, CA)	California Institute of Technology (Pasadena, CA)	See US6924497 (B2) below
20	US6924497 (B2) — 2005-08-02	Systems for measuring stresses	SURESH SUBRA [US]; ROSAKIS ARES J [US]	SURESH SUBRA, ; ROSAKIS ARES J, ; CALIFORNIA	14.07.2004: Final Rejection 21.05.2012: Communication - Re: Power of Attorney (PTOL-308)

	Application US10/630,512	in line features formed on substrates		INSTITUTE OF TECHNOLOGY	
21	US6311135 (B1) — 2001-10-30	Method and apparatus for determining preexisting stresses based on indentation or other mechanical probing of the material	SURESH SUBRA [US]; GIANNAKOPOULOS ANTONIOS [US]	INVENTIUM LLC [US]	1998-05-26: Priority to US09/084,672 Status: Expired - Fee Related
22	US6155104 (A) — 2000-12-05	Method and apparatus for determining preexisting stresses based on indentation or other mechanical probing of a material	SURESH SUBRA [US]; GIANNAKOPOULOS ANTONIOS [US]	SURESH SUBRA [US]	Status: Expired - Fee Related
23	EP1000336 (A1) — 2000-05-17	METHOD AND APPARATUS FOR DETERMINING PREEXISTING STRESSES BASED ON INDENTATION OR OTHER MECHANICAL PROBING OF THE MATERIAL	SURESH SUBRA [US]; GIANNAKOPOULOS ANTONIOS [US]	INVENTIUM LLC [US]	13.02.2002: Application deemed to be withdrawn (non-payment of renewal fee)
24	WO02073162 (A3) — 2003-09-18	SYSTEMS AND METHODS FOR ESTIMATION AND ANALYSIS OF	SURESH SUBRA; DAO MING; CHOLLACOOP NUWONG; VAN VLIET KRYSTYN J; VENKATESH T	MASSACHUSETTS INST TECHNOLOGY [US]	24.09.2003: International Preliminary Examination Report "...The application is deemed to be withdrawn...Status updated on

		MECHANICAL PROPERTY DATA	A		02.04.2004…Database last updated on 24.05.2021…”
25	US6924497 (B2) — 2005-08-02 Application US10/630,512	Systems for measuring stresses in line features formed on substrates	SURESH SUBRA [US]; ROSAKIS ARES J [US]	SURESH SUBRA, ; ROSAKIS ARES J, ; CALIFORNIA INSTITUTE OF TECHNOLOGY	2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-05-07: Assigned to KLA CORPORATION.
26	6,600,565 09/560,719 April 27, 2000 (see US6600565B1)	Real-time evaluation of stress fields and properties in line features formed on substrates	Suresh; Subra (Wellesley, MA), Rosakis; Ares J. (Altadena, CA)	California Institute of Technology (Pasadena, CA)	?
27	6,513,389 09/843,612 February 4, 2003 or US6513389 (B2) — 2003-02-04	Technique for determining curvatures of embedded line features on substrates	Suresh; Subra (Wellesley, MA), Park; Tae-Soon (Cambridge, MA)	California Institute of Technology (Pasadena, CA)	2003-02-04: Publication of US6513389B2; 2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-04-27: Anticipated expiration; 2020-05-07: Assigned to KLA CORPORATION; Status Expired - Lifetime
28	EP1277036 (A2) — 2003-01-22	TECHNIQUE FOR DETERMINING CURVATURES OF EMBEDDED LINE FEATURES ON SUBSTRATES	SURESH SUBRA [US]; PARK TAE-SOON [US]	CALIFORNIA INST OF TECHN [US]	14.12.2006: Application deemed to be withdrawn (non-payment of renewal fee)
29	WO0181856 (A3) — 2002-07-18	TECHNIQUE FOR DETERMINING CURVATURES OF EMBEDDED LINE FEATURES ON SUBSTRATES	SURESH SUBRA; PARK TAE-SOON	CALIFORNIA INST OF TECHN [US]	25.10.2002: International Preliminary Examination Report “…Novelty… NONE…Inventive Step …NONE …Industrial Applicability … NONE…” The application is deemed to be withdrawn, Status updated on 06.04.2007, Database last updated on 24.05.2021
30	US2002021452 (A1) — 2002-02-21	Technique for determining curvatures of embedded line features on substrates	SURESH SUBRA [US]; PARK TAE-SOON [US]	SURESH SUBRA, ; PARK TAE-SOON, ; CALIFORNIA INSTITUTE OF TECHNOLOGY	2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-04-27: Anticipated expiration; 2020-05-07: Assigned to KLA CORPORATION; Status Expired - Lifetime
31	CN1764898 (A) — 2006-04-26	Analysis and monitoring of	SUBRA ROSAKIS ARES J PARK TAE- [US]	CALIFORNIA INSTITUE OF TECHNOL [US]	?

		stresses in embedded lines and vias integrated on substrates			
32	WO2004068554 (A8) — 2005-11-17 Also published as EP1588254 CN1764898 US20050030551 JP2006519476 KR1020050092051	ANALYSIS AND MONITORING OF STRESSES IN EMBEDDED LINES AND VIAS INTEGRATED ON SUBSTRATES	ROSAKIS ARES J [US]; PARK TAE-SOON [US]; SURESH SUBRA [US]	CALIFORNIA INST OF TECHN [US]; ROSAKIS ARES J [US]; PARK TAE-SOON [US]; SURESH SUBRA [US]	25.05.2021: International Application Status Report ?
33	EP1588254 (A2) — 2005-10-26	ANALYSIS AND MONITORING OF STRESSES IN EMBEDDED LINES AND VIAS INTEGRATED ON SUBSTRATES	ROSAKIS ARES J [US]; PARK TAE-SOON [US]; SURESH SUBRA [US]	CALIFORNIA INST OF TECHN [US]	08.10.2007: Application deemed to be withdrawn "...Status updated on 14.03.2008...Database last updated on 24.05.2021..."
34	KR20050092051 (A) — 2005-09-16	ANALYSIS AND MONITORING OF STRESSES IN EMBEDDED LINES AND VIAS INTEGRATED ON SUBSTRATES	ROSAKIS ARES J [US]; PARK TAE SOON [US]; SURESH SUBRA [US]	CALIFORNIA INST OF TECHN [US]	Granted, Korea
35	US2005030551 (A1) — 2005-02-10	Analysis and monitoring of stresses in embedded lines and vias integrated on substrates	ROSAKIS ARES J [US]; PARK TAE-SOON [US]; SURESH SUBRA [US]	ROSAKIS ARES J, ; PARK TAE-SOON, ; SURESH SUBRA	08.09.2009: Abandonment
36	EP1428242 (A2) — 2004-06-16	REAL-TIME EVALUATION OF STRESS FIELDS AND PROPERTIES IN LINE FEATURES	SURESH SUBRA [US]; ROSAKIS ARES J [US]	CALIFORNIA INST OF TECHN [US]	07.12.2006: Application deemed to be withdrawn "...Status updated on 30.03.2007...Database last updated on 24.05.2021..."

		FORMED ON SUBSTRATES			
37	US6600565 (B1) — 2003-07-29	Real-time evaluation of stress fields and properties in line features formed on substrates	SURESH SUBRA [US]; ROSAKIS ARES J [US]	CALIFORNIA INST OF TECHN [US]	2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-04-27: Anticipated expiration; 2020-05-07: Assigned to KLA CORPORATION; Status Expired – Lifetime.
38	US2004075825 (A1) — 2004-04-22	Real-time evaluation of stress fields and properties in line features formed on substrates	SURESH SUBRA [US]; ROSAKIS ARES J [US]	SURESH SUBRA, ; ROSAKIS ARES J, ; CALIFORNIA INSTITUTE OF TECHNOLOGY	14.07.2004: Final Rejection
39	WO0182335 (A3) — 2004-03-25	REAL-TIME EVALUATION OF STRESS FIELDS AND PROPERTIES IN LINE FEATURES FORMED ON SUBSTRATES	SURESH SUBRA [US]; ROSAKIS ARES J [US]	CALIFORNIA INST OF TECHN [US]; SURESH SUBRA [US]; ROSAKIS ARES J [US]	5.03.2004: Published International Application
40	AU5572301 (A) — 2001-11-07	Real-time evaluation of stress fields and properties in line features formed on substrates	SURESH SUBRA; ROSAKIS ARES J	CALIFORNIA INST OF TECHN	
41	EP1390691 (A2) — 2004-02-25	DETERMINING LARGE DEFORMATIONS AND STRESSES OF LAYERED AND GRADED	SURESH SUBRA [US]; BLECH I [US]; ROSAKIS ARES J [US]; GIANNAKOPOULOS A [US]	CALIFORNIA INST OF TECHN [US]	15.01.2007: Application deemed to be withdrawn (non-payment of renewal fee)

		STRUCTURES TO INCLUDE EFFECTS OF BODY FORCES			
42	WO2002099373 (A3) — 2003-08-07 Publication date: 2002-12-12	DETERMINING LARGE DEFORMATIONS AND STRESSES OF LAYERED AND GRADED STRUCTURES TO INCLUDE EFFECTS OF BODY FORCES	SURESH SUBRA [US]; BLECH ILAN [US]; ROSAKIS ARES J [US]; GIANNAKOPOULOS ANTONIOS [GR]	CALIFORNIA INST OF TECHN [US]; SURESH SUBRA [US]; BLECH ILAN [US]; ROSAKIS ARES J [US]; GIANNAKOPOULOS ANTONIOS [GR]	25.11.2003: International Preliminary Examination Report confirmed
43	US2003106378 (A1) — 2003-06-12 Application US10/157,735	Determining large deformations and stresses of layered and graded structures to include effects of body forces	GIANNAKOPOULOS ANTONIOS [GR]; SURESH SUBRA [US]; ROSAKIS ARES J [US]; BLECH ILAN [US]	GIANNAKOPOULOS ANTONIOS, ; SURESH SUBRA, ; ROSAKIS ARES J, ; BLECH ILAN, ; CALIFORNIA INSTITUTE OF TECHNOLOGY	2004-08-24: Publication of US6781702B2; 2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-05-07: Assigned to KLA CORPORATION; Status Active. See US6781702B2.
44	AU4205299 (A) — 1999-12-13	Method and apparatus for determining preexisting stresses based on indentation or other mechanical probing of the material	SURESH SUBRA; GIANNAKOPOULOS ANTONIOS	INVENTIUM LLC	Status Abandoned
45	US5999887 (A) — 1999-12-07	Method and apparatus for determination of mechanical properties of functionally-graded materials	GIANNAKOPOULOS ANTONIOS E [US]; SURESH SUBRA [US]	MASSACHUSETTS INST TECHNOLOGY [US]	Interestingly a search on this patent produced the following hit on Google Patent: US1071430A (Apparatus for testing the hardness of metals) by William Herbert Keen filed in 1913.
46	EP0867708 (A1) — 1998-09-30	Method and apparatus for determination of	GIANNAKOPOULOS ANTONIOS E [US]; SURESH SUBRA [US]	MASSACHUSETTS INST TECHNOLOGY [US]	10.10.2003: Application deemed to be withdrawn (non-payment of renewal fee)

		mechanical properties of functionally-graded materials			
47	WO9961883 (A1) — 1999-12-02	METHOD AND APPARATUS FOR DETERMINING PREEXISTING STRESSES BASED ON INDENTATION OR OTHER MECHANICAL PROBING OF THE MATERIAL	SURESH SUBRA [US]; GIANNAKOPOULOS ANTONIOS [US]	INVENTIUM LLC [US]	
48	US6247355 (B1) — 2001-06-19 Application US09/026,889 Priority to US08/632,665	Depth sensing indentation and methodology for mechanical property measurements	SURESH SUBRA [US]; ALCALA JORGE [ES]; GIANNAKOPOULOS ANTONIOS E [US]	MASSACHUSETTS INST TECHNOLOGY [US]	See US6134954 (A) Application US09/026,889 events: 1996-04-15: Priority to US08/632,665 1998-02-19: Application filed by Massachusetts Institute of Technology 1998-02-19: Priority to US09/026,889 2001-06-19: Application granted 2001-06-19: Publication of US6247355B1 2016-04-15: Anticipated expiration Status Expired - Fee Related
49	US6134954 (A) — 2000-10-24 Application US08/632,665	Depth sensing indentation and methodology for mechanical property measurements	SURESH SUBRA [US]; ALCALA JORGE [US]; GIANNAKOPOULOS ANTONIOS E [US]	MASSACHUSETTS INST TECHNOLOGY [US]	2000-10-24: Application granted 2016-04-15: Anticipated expiration Status Expired - Fee Related. US6247355 (B1)
50	EP0894259 (A2) — 1999-02-03	DEPTH SENSING INDENTATION AND METHODOLOGY FOR MECHANICAL PROPERTY MEASUREMENTS	SURESH SUBRA [US]; ALCALA JORGE [US]; GIANNAKOPOULOS ANTONIOS E [US]	MASSACHUSETTS INST TECHNOLOGY [US]	10.01.2003: Application deemed to be withdrawn (no reply to communication from the Examining Division)
51	WO9739333 (A3) — 1998-04-09	DEPTH SENSING INDENTATION AND	SURESH SUBRA; ALCALA JORGE; GIANNAKOPOULOS	MASSACHUSETTS INST	

		METHODOLOGY FOR MECHANICAL PROPERTY MEASUREMENTS	ANTONIOS E	TECHNOLOGY [US]	
52	AU2002255669 (A1) — 2002-09-24	Systems and methods for estimation and analysis of mechanical property data	VLIET KRYSTYN J VAN; DAO MING; VENKATESH T A; SURESH SUBRA; CHOLLACOOP NUWONG	MASSACHUSETTS INST TECHNOLOGY	Status Abandoned
53	AU2674297 (A) — 1997-11-07	Depth sensing indentation and methodology for mechanical property measurements	SURESH SUBRA; ALCALA JORGE; GIANNAKOPOULOS ANTONIOS E	MASSACHUSETTS INST TECHNOLOGY	Status Abandoned
54	US2003060987 (A1) — 2003-03-27	Systems and methods for estimation and analysis of mechanical property data associated with indentation testing	DAO MING [US]; CHOLLACOOP NUWONG [US]; VAN VLIET KRYSTYN J [US]; VENKATESH THANDAMPALAYAM A [US]; SURESH SUBRA [US]	DAO MING, ; CHOLLACOOP NUWONG, ; VAN VLIET KRYSTYN J, ; VENKATESH THANDAMPALAYAM A, ; SURESH SUBRA	Status Abandoned
55	US5847283 (A) — 1998-12-08	Method and apparatus for the evaluation of a depth profile of thermo-mechanical properties of layered and graded materials and coatings	FINOT MARC [US]; KESLER OLIVERA [US]; SURESH SUBRA [US]	MASSACHUSETTS INST TECHNOLOGY [US]	1998-07-14: Assigned to NAVY, SECRETARY OF THE UNITED STATES OF AMERICA; 1998-12-08: Publication of US5847283A; 1998-12-08: Application granted; 2003-07-15: Assigned to U.S. DEPARTMENT OF ENERGY; 2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2016-07-03: Anticipated expiration; Status Expired - Lifetime
56	AU3650697 (A) — 1998-01-21	Method and apparatus for the evaluation of a depth profile of thermo-mechanical properties of	FINOT MARC; KESLER OLIVERA; SURESH SUBRA	MASSACHUSETTS INST TECHNOLOGY	Status Abandoned

		layered and graded materials and coatings			
57	WO9800698 (A1) — 1998-01-08	METHOD AND APPARATUS FOR THE EVALUATION OF A DEPTH PROFILE OF THERMO-MECHANICAL PROPERTIES OF LAYERED AND GRADED MATERIALS AND COATINGS	FINOT MARC; KESLER OLIVERA; SURESH SUBRA	MASSACHUSETTS INST TECHNOLOGY [US]	Status Abandoned
58	WO9840326 (A1) — 1998-09-17	FUNCTIONALLY-GRADED MATERIALS	SURESH SUBRA; GIANNAKOPOULOS ANTONIOS E; PADTURE NITIN P; JITCHAROEN JUTHAMAS	MASSACHUSETTS INST TECHNOLOGY [US]	
59	EP0968153 (B1) — 2002-06-19	FUNCTIONALLY-GRADED MATERIALS	SURESH SUBRA [US]; GIANNAKOPOULOS ANTONIOS E [US]; PADTURE NITIN P [US]; JITCHAROEN JUTHAMAS [US]	MASSACHUSETTS INST TECHNOLOGY [US]; UNIV CONNECTICUT [US]	10.05.2002: Decision to grant a European patent; Status Expired - Lifetime
60	AU6560598 (A) — 1998-09-29	Functionally-graded materials	SURESH SUBRA; GIANNAKOPOULOS ANTONIOS E; PADTURE NITIN P; JITCHAROEN JUTHAMAS	MASSACHUSETTS INST TECHNOLOGY	Status Abandoned
61	DE69806131 (T2) — 2002-10-02	FUNCTIONALLY-GRADED MATERIALS	SURESH SUBRA [US]; GIANNAKOPOULOS E [US]; PADTURE P [US]; JITCHAROEN JUTHAMAS [US]	MASSACHUSETTS INST TECHNOLOGY [US]; UNIV CONNECTICUT FARMINGTON [US]	2018-03-14: Anticipated expiration; Status Expired - Fee Related
62	US6641893B1 6,641,893 09/062,870 Filed: April 20, 1998	Functionally-graded materials and the engineering of tribological resistance at	Suresh; Subra (Wellesley, MA), Giannakopoulos; Antonios E. (Somerville, MA), Olsson; Marten (Solna, SE), Thampuran; Rajendran (Singapore, SG), Jorgensen; Ole	Massachusetts Institute of Technology (Cambridge, MA) University of Connecticut (Farmington, CT)	US6641893B1: 1998-04-20: Priority to US09/062,870; 1999-07-12: Assigned to NAVY, SECRETARY OF THE UNITED STATES OF AMERICA; 2001-12-31: Assigned to MASSACHUSETTS INSTITUTE OF TECHNOLOGY; 2001-12-31: Assigned to CONNECTICUT, UNIVERSITY OF; Assignors: PADTURE, NITIN, JITCHAROEN, JUTHAMAS; 2002-07-12: Assigned to NATIONAL SCIENCE FOUNDATION; 2003-11-04: Publication of

		surfaces	(Virum, DK), Padture; Nitin P. (Storrs, CT), Jitcharoen; Juthamas (Willimantic, CT)		US6641893B1; 2003-11-04: Application granted; 2006-06-30: Assigned to AIR FORCE, UNITED STATES; 2017-03-14: Anticipated expiration; Status Expired - Fee Related
63	6,781,702 10/157,735 Filed: May 28, 2002	Determining large deformations and stresses of layered and graded structures to include effects of body forces	Giannakopoulos; Antonios (Athens, GR), Suresh; Subra (Wellesley, MA), Rosakis; Ares J. (Altadena, CA), Blech; Ilan (Los Altos, CA)	California Institute of Technology (Pasadena, CA)	
64	US6781702 (B2) — 2004-08-24 Application US10/157,735	Determining large deformations and stresses of layered and graded structures to include effects of body forces	GIANNAKOPOULOS ANTONIOS [GR]; SURESH SUBRA [US]; ROSAKIS ARES J [US]; BLECH ILAN [US]	CALIFORNIA INST OF TECHN [US]	2005-03-07: Assigned to VENTURE LENDING & LEASING IV, INC., AS AGENT; 2019-12-30: Assigned to VEECO INSTRUMENTS INC.; 2020-05-07: Assigned to KLA CORPORATION; Status Active
65	AU2002346685 (A1) — 2002-12-16	Determining large deformations and stresses of layered and graded structures to include effects of body forces	ROSAKIS ARES J; BLECH ILAN; SURESH SUBRA; GIANNAKOPOULOS ANTONIOS	CALIFORNIA INST OF TECHN	Status Abandoned
66	WO2012051572 (A1) — 2012-04-19	A HUMANIZED NON-HUMAN MAMMAL MODEL OF MALARIA AND USES THEREOF	AMALADOSS ANBURAJ [SG]; CHEN QINGFENG [SG]; DAO MING [US]; PREISER PETER [SG]; CHEN JIANZHU [US]; SURESH SUBRA [US]	MASSACHUSETTS INST TECHNOLOGY [US]; UNIV NANYANG TECH [SG]; AMALADOSS ANBURAJ [SG]; CHEN QINGFENG [SG]; DAO MING [US]; PREISER PETER [SG]; CHEN JIANZHU [US]; SURESH SUBRA [US]	16.04.2013: "...Non-establishment of opinion with regard to novelty, inventive step and insdustrial applicability The application is deemed to be withdrawn, Status updated on 04.10.2013, Database last updated on 24.05.2021
67	US2011287948 (A1) — 2011-11-24	MEASUREMENT OF MATERIAL PROPERTIES AND RELATED METHODS AND COMPOSITIONS	SURESH SUBRA [US]; ALMEIDA CARVALHO PATRICIA MARIA [PT]; DIEZ SILVA MONICA [US]; DAO MING [US]	SURESH SUBRA [US]; ALMEIDA CARVALHO PATRICIA MARIA [PT]; DIEZ SILVA MONICA [US]; DAO MING [US]; MASSACHUSETTS INST	06.12.2013: Abandonment

		BASED ON CYTOADHERENCE		TECHNOLOGY [US]	
68	US2012064505 (A1) — 2012-03-15	MEASUREMENT OF MATERIAL PROPERTIES AND RELATED METHODS AND COMPOSITIONS	SURESH SUBRA [US]; HAN JONGYOON [US]; BOW HANSEN [US]; HUANG SHA [US]; DIEZ SILVA MONICA [US]; PIVKIN IGOR V [US]; BERRIS MICHAL MICHELLE [US]; DAO MING [US]	(SURESH SUBRA, ; HAN JONGYOON, ; BOW HANSEN, ; HUANG SHA, ; DIEZ SILVA MONICA, ; PIVKIN IGOR V, ; BERRIS MICHAL (MICHELLE), ; DAO MING, ; MASSACHUSETTS INSTITUTE OF TECHNOLOGY)	02.10.2018: Abandonment
69	WO2011119492 (A3) — 2012-04-26	METHODS AND COMPOSITIONS RELATED TO THE MEASUREMENT OF MATERIAL PROPERTIES	SURESH SUBRA [US]; HAN JONGYOON [US]; BOW HANSEN [US]; HUANG SHA [US]; DIEZ SILVA MONICA [US]; PIVKIN IGOR V [US]; BERRIS MICHAL MICHELLE [US]; DAO MING [US]; KARNIADAKIS GEORGE E [US]; CASWELL BRUCE [US]; FEDOSV DMITRY [DE]; QUINN DAVID J [US]; CHEN JIANZHU [US]; CHANG IRENE YIN-TING; ALMEIDA CARVALHO PATRICIA MARIA [PT]	MASSACHUSETTS INST TECHNOLOGY [US]; UNIV BROWN RES FOUND [US]; SURESH SUBRA [US]; HAN JONGYOON [US]; BOW HANSEN [US]; HUANG SHA [US]; DIEZ SILVA MONICA [US]; PIVKIN IGOR V [US]; BERRIS MICHAL MICHELLE [US]; DAO MING [US]; KARNIADAKIS GEORGE E [US]; CASWELL BRUCE [US]; FEDOSV DMITRY [DE]; QUINN DAVID J [US]; CHEN JIANZHU [US]; CHANG IRENE YIN-TING; ALMEIDA CARVALHO PATRICIA MARIA [PT]	25.09.2012: International Preliminary Report on Patentability Chapter I “Lack of unity of invention…”
70	US2012064505 (A1) — 2012-03-15	MEASUREMENT OF MATERIAL PROPERTIES AND RELATED METHODS AND COMPOSITIONS	SURESH SUBRA [US]; HAN JONGYOON [US]; BOW HANSEN [US]; HUANG SHA [US]; DIEZ SILVA MONICA [US]; PIVKIN IGOR V [US]; BERRIS MICHAL MICHELLE	SURESH SUBRA [US]; HAN JONGYOON [US]; BOW HANSEN [US]; HUANG SHA [US]; DIEZ SILVA MONICA [US]; PIVKIN IGOR V [US]; BERRIS MICHAL MICHELLE	02.10.2018: Abandonment

			[US]; DAO MING [US]	[US]; DAO MING [US]; MASSACHUSETTS INST TECHNOLOGY [US]	
71	US2011289043 (A1) — 2011-11-24	COMPUTATIONAL METHODS AND COMPOSITIONS	SURESH SUBRA [US]; KARNIADAKIS GEORGE E [US]; CASWELL BRUCE [US]; PIVKIN IGOR V [US]; FEDOSOV DMITRY [DE]; QUINN DAVID J [US]; DAO MING [US]	SURESH SUBRA [US]; KARNIADAKIS GEORGE E [US]; CASWELL BRUCE [US]; PIVKIN IGOR V [US]; FEDOSOV DMITRY [DE]; QUINN DAVID J [US]; DAO MING [US]; UNIV BROWN RES FOUND [US]; MASSACHUSETTS INST TECHNOLOGY [US]	22.12.2014: Abandonment

Table 7. Patents apparently actually granted to Suresh and others		
#	**Patent ID — date of application**	**Patent title**
1	US9134294 (B2) — 2015-09-15	Method and apparatus for high throughput diagnosis of diseased cells with microchannel devices
3	US6155104 (A) — 2000-12-05	Method and apparatus for determining preexisting stresses based on indentation or other mechanical probing of a material
4	US6924497 (B2) — 2005-08-02	Systems for measuring stresses in line features formed on substrates
5	US6513389 (B2) — 2003-02-04	Technique for determining curvatures of embedded line features on substrates
6	KR20050092051 (A) — 2005-09-16	ANALYSIS AND MONITORING OF STRESSES IN EMBEDDED LINES AND VIAS INTEGRATED ON SUBSTRATES
7	US6600565 (B1) — 2003-07-29	Real-time evaluation of stress fields and properties in line features formed on substrates
8	US5999887 (A) — 1999-12-07	Method and apparatus for determination of mechanical properties of functionally-graded materials
9	US6247355 (B1) — 2001-06-19	Depth sensing indentation and methodology for mechanical property measurements
11	US5847283 (A) — 1998-12-08	Method and apparatus for the evaluation of a depth profile of thermo-mechanical properties of layered and graded materials and coatings
12	EP0968153 (B1) — 2002-06-19	FUNCTIONALLY-GRADED MATERIALS
13	US6641893B1 — 1998-04-20	Functionally-graded materials and the engineering of tribological resistance at surfaces
14	US6781702 (B2) — 2004-08-24	Determining large deformations and stresses of layered and graded structures to include effects of body forces

Table 8. Sources used for patent analysis	
1	https://www.epo.org
2	https://patft.uspto.gov/netahtml/PTO/index.html
3	https://www.uspto.gov/learning-and-resources/support-centers/electronic-business-center/kind-codes-included-uspto-patent
4	https://www.wipo.int/patentscope/en/
5	https://patents.google.com
6	https://www.library.cmu.edu

Table 9. Plagiarized thesis supervised by Suresh.		
	Hardin 2006	***Zhang 2007***
1	"…Of the many micromachined diagnostic devices currently being developed, suspended microchannel resonator technology seems unique in that is not a scaling down of an existing technique and does not require labeling of the target cell…"	"…Of many diagnostic devices and technology developed, microfluidics could be superior in terms of ease of fabrication, cost, portability, speed and sensitivity…"
2	"…Technical issues aside, there must be a market to support the development and manufacture of this device…"	"…Besides technical issues, the development and manufacturing of those devices must be supported by a market…"
3	"…There are many business models that can be used to commercialize this technology. Depending on the amount of investment available before commercialization, different models are possible to try. When taking into consideration the current state of technology in the field of rare cell detection, it would probably be wisest to outsource manufacturing and focus on development to get a functional commercialized device more rapidly…"	"…In order to commercialize this technology, several business models could be used depends on the amount of investment available. And it is wise to focus on the development of functional commercialized device first, with outsourcing manufacturers…"
4	"…Intellectual property (IP) of medical devices has to be carefully managed because of the long time frame development issues…"	"…Currently this technology is still at laboratory research stage, thus, the intellectual property (IP) of this device should be carefully managed due to long term development issues.."
5	"…Furthermore, it is unlikely that the malaria market will get to a position in the immediate future to support research and development of the malaria diagnosis application.	"…Besides, it is hard to find a position in malaria market in near future to support research and development of diagnostic device, thus the resistance to enter the malaria market is quite high at current stage…"
6	"…Should this occur after the expiration of the SMR patent, that is not of particular concern because the packaging (user interface, filters, casing, etc) is probably the key intellectual property…"	"… However, it is not quite a problem for the packaging such as user interface, casing, etc…"
7	"…With good planning and good luck it should be possible to hold key IP for SMR technology for decades…"	"…With good planning, it is possible to hold IP for this technology for a few years…"
8	"…Initially, the SMR patent should protect the technology from being copied…"	"…The first patent for the microfluidic device should be able to prevent the channel design to be copied…"
9	"…Any mass spectrometry technology that can be modified for fast analysis can eventually threaten the preeminence of SMR for diagnostic applications. In order to avoid this, the patents on the final devices need to refer to the SMR by its function first including specificity later, if necessary. Although this will not allow expansion into the other mass spectrometry technologies, it will facilitate the blocking of those technologies from entering this application. This being an initial patent, it may not last for the entire functional lifetime of the technology but, hopefully, it will last for most of the needed time for the cancer diagnosis application…"	"… However, currently there are many microfluidic devices exist, although they are not purposely designed for malaria diagnosis, the channel designs should be similar to our technology. Thus in order to avoid this, in the patent for the final device, the actual dimension of the channels and the purpose of the device should be specified. Although the specified patent will not allow the expansion of the design into other microfluidics field, it could effectively prevent other technology entering this field. As a first patent, it should last for the entire lifetime of the technology, and the worst thing is that, it may expire even before the technology is fully utilized, and a careful plan is needed. Patent on packaging design should be followed and hopefully this patent could last for the needed time for malaria diagnosis…."
10	"…The existing markets for malaria detection are very small and therefore not very forgiving…"	"…The existing malaria market is not so large, and there are already many competitors in the market already…"

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AUTHOR'S NOTE: I apologize for incomplete references below. While working on this report, my flat was broken into and my laptops rendered unusable. Also, my bank account at OCBC was frozen and emptied of every last dollar. Under the circumstances, I am unable to finalize this reference list. I may do so at a later date. If you have trouble finding a reference, please do not hesitate to contact me.

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