UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

In Re:	U.S. Patent 7,029,774	:	Attorney Docket No. 070103.0332
Inventor:	James A. Greczyna	:	
Filed:	May 23, 2005	:	
Issued:	April 18, 2006	:	IPR No. Unassigned
Assignee:	Sony Corporation		

Title: Magnetic Recording Medium With Backside To Decrease Recording Surface Embossment

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Submitted Electronically via the Patent Review Processing System

DECLARATION OF DR. BART RAEYMAEKERS

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I, Dr. Bart Raeymakers, declare as follows:

1. I am an Associate Professor in the Department of Mechanical Engineering at the University of Utah. I have prepared this report as an expert witness retained by FUJIFILM Corporation. In this report I give my opinions regarding U.S. Patent No. 7,029,774 ("the '774 Patent") and measurements that I conducted. I provide technical bases for these opinions as appropriate.

2. This report contains statements of my opinions formed to date and the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other expert witnesses. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein. For my efforts in connection with the preparation of this declaration I have been compensated at my standard rate for this type of consulting activity. My compensation is in no way contingent on the results of these or any other proceedings relating to the above-captioned patent.

I. Background and Qualifications

3. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as Attachment A to this report.

A. Educational Background

4. I received a Bachelor of Science degree in Electromechanical Engineering from the Katholieke Hogeschool (KaHo) St. Lieven in Ghent, Belgium, in 2002, and a Master of Science degree in Electromechanical Engineering from the Vrije Universiteit Brussel, Belgium, in 2004. I furthermore received a Master of Science in Mechanical Engineering in 2005 and Ph.D. in Mechanical Engineering in 2007, both from the University of California, San Diego. Finally, I obtained a Master of Business Administration in 2009 from the Massachusetts Institute of Technology. I have expertise in the mechanical aspects of magnetic tapes, including their surface properties and dynamics as they move through a tape drive and interact with several tape drive components.

B. Career History

5. After finishing my education, I became a post-doctoral fellow at the Los Alamos National Laboratory in New Mexico in 2009. In October 2010, I became a tenure-track assistant professor in the Department of Mechanical Engineering at the University of Utah. Since July 2016 I have been an associate professor with tenure. My research is in the area of tribology with an emphasis on micro- and nanoscale contact and lubrication, and in the area of nanomanufacturing with an emphasis on directed self-assembly. My primary research applications are in micro- and nanoscale surface engineering,

(elasto)hydrodynamic lubrication, ultra-thin protective coatings, and design and manufacturing of novel materials. My expertise in magnetic tape recording was formed during my Ph.D. research, where I extensively studied magnetic tape surface topography, magnetic tape dynamics, and interactions between magnetic tape and tape drive components.

C. Publications and Patents

6. I have (co-)authored 41 journal publications and 35 refereed conference publications. I am also a listed inventor of U.S. Patent No. 8,722,155, "Method to Manufacture Bit Patterned Magnetic Recording Media," and U.S. Patent application Publication No. 2015/0148910, "Prosthetic Joint."

II. Understanding of the Law

7. I have applied the following legal principles provided to me by counsel in arriving at the opinions set forth in this report.

A. Legal Standard for Prior Art

8. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim.

9. I understand that a U.S. or foreign patent qualifies as prior art to a challenged patent if the date of issuance of the patent is prior to the invention of the challenged patent. I further understand that a printed publication, such as a book or an article published in a magazine or trade publication, qualifies as prior

art to a challenged patent under § 102(a) if the date of publication is prior to the invention of the challenged patent.

10. I understand that a U.S. or foreign patent qualifies as prior art to a challenged patent if the date of issuance of the patent is more than one year before the filing date of the challenged patent. I further understand that a printed publication, such as a book or an article published in a magazine or trade publication, constitutes prior art to a challenged patent under § 102(b) if the publication occurs more than one year before the filing date of the challenged patent.

11. I understand that a U.S. patent qualifies as prior art to the challenged patent under § 102(e)(2) if the application for that patent was filed in the United States before the invention of the challenged patent.

12. I understand that a publication of a U.S. patent application qualifies as prior art to the challenged patent under § 102(e)(1) if the application was filed in the United States before the invention of the challenged patent.

13. I understand that to qualify as prior art, a reference must contain an enabling disclosure that allows one of ordinary skill to practice the claims without undue experimentation.

14. I understand that documents and materials that qualify as prior art can be used to invalidate a patent claim as anticipated or as obvious.

B. Legal Standard for Anticipation

15. I understand that, once the claims of a patent have been properly construed, the second step in determining anticipation of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

16. I understand that a prior art reference "anticipates" a challenged claim, and thus renders the claim invalid, if all elements of the claim are disclosed in that prior art reference, either explicitly or inherently (i.e., necessarily present or implied).

17. I understand that a prior art product "inherently anticipates" a claimed product when the prior art product and claimed product are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes. A newly-discovered property of an old article may not be patentable if the article itself is not new.

18. I understand that a patent is anticipated if, before such person's invention thereof, the invention was made in this country by another inventor who had not abandoned, suppressed, or concealed it.

19. I have written this report with the understanding that in an *inter partes* review anticipation must be shown by a preponderance of the evidence.

C. Legal Standard for Obviousness

20. I have been instructed by counsel on the law regarding obviousness, and understand that even if a patent is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the pertinent art.

21. I understand that a person of ordinary skill in the art provides a reference point from which the prior art and claimed invention should be viewed. This reference point prevents a person of ordinary skill from using one's insight or hindsight in deciding whether a claim is obvious.

22. I also understand that an obviousness determination includes the consideration of various factors such as (1) the scope and content of the prior art, (2) the differences between the prior art and the challenged claims, (3) the level of ordinary skill in the pertinent art, and (4) the existence of secondary considerations such as commercial success, long-felt but unresolved needs, failure of others, etc.

23. I am informed that secondary indicia of non-obviousness may include (1) a long felt but unmet need in the prior art that was satisfied by the invention of the patent; (2) commercial success or lack of commercial success of processes covered by the patent; (3) unexpected results achieved by the invention; (4) praise of the invention by others skilled in the art; (5) taking of licenses under the patent

by others; and (6) deliberate copying of the invention. I also understand that there must be a relationship between any such secondary indicia and the invention. I further understand that contemporaneous and independent invention by others is a secondary consideration supporting an obviousness determination.

24. I understand that an obviousness evaluation can be based on a combination of multiple prior art references. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the nexus linking two or more prior art references is simple common sense. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may be supplied by the direction of the marketplace.

25. I understand that if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

26. I also understand that practical and common sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. I further understand that a person of ordinary skill in the art looking to overcome a problem will often be able to fit the

teachings of multiple publications together like pieces of a puzzle, although the prior art need not be like two puzzle pieces that must fit perfectly together. I understand that obviousness analysis therefore takes into account the inferences and creative steps that a person of ordinary skill in the art would employ under the circumstances.

27. I understand that a particular combination may be proven obvious by showing that it was obvious to try the combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp because the result is likely the product not of innovation but of ordinary skill and common sense.

28. I understand that the combination of familiar elements according to known methods may be proven obvious when it does no more than yield predictable results. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, obviousness likely bars its patentability.

29. It is also my understanding that there are additional considerations that may be used as further guidance as to when a claim is obvious, including the following:

- the claimed invention is a simple substitution of one known element for another to obtain predictable results;
- the claimed invention uses known techniques to improve similar devices or methods in the same way;
- the claimed invention applies a known technique to a known device or method that is ready for improvement to yield predictable results; and
- there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims.

30. It is further my understanding that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

31. I understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the common sense of one of skill in the art.

32. I understand that a person of ordinary skill could have combined two pieces of prior art or substituted one prior art element for another if the substitution can be made with predictable results, even if the swapped-in element is different

from the swapped-out element. In other words, the prior art need not be like two puzzle pieces that must fit together perfectly. The relevant question is whether prior art techniques are interoperable with respect to one another, such that that a person of skill would view them as a design choice, or whether a person of skill could apply prior art techniques into a new combined system.

33. In sum, my understanding is that prior art teachings are properly combined where a person of ordinary skill in the art having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

34. I have been informed and understand that the obviousness analysis requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

35. I have written this report with the understanding that in an *inter partes* review obviousness must be shown by a preponderance evidence.

D. Legal Standard for Claim Construction

36. I have been instructed by counsel on the law regarding claim construction and patent claims, and understand that a patent may include two types of claims, independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to all of the limitations recited in the claim from which it depends.

37. It is my understanding that in proceedings before the P.T.A.B. the claims of an unexpired patent are to be given their broadest reasonable interpretation in light of the specification from the perspective of one of skill in the art. It is my further understanding that claim terms of an expired patent are given the meaning the term would have to a person of ordinary skill in the art at the time of the invention, in view of the specification and file history. I understand that the standard used for expired patents is similar to that used in district court litigation, and that this standard is sometimes referred to as the *Phillips* standard.

38. It is my understanding that the broadest reasonable interpretation of a claim term may be the same as or broader than the construction of a term under the *Phillips* standard, but it cannot be narrower.

39. In comparing the claims of the ’774 Patent to the prior art, I have carefully considered the ’774 Patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

40. I understand that to determine how a person of ordinary skill would understand a claim term, one should look to those sources available that show what a person of skill in the art would have understood disputed claim language to mean. Such sources include the words of the claims themselves, the remainder of the patent’s specification, the prosecution history of the patent (all considered “intrinsic” evidence), and “extrinsic” evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.

41. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent specification, and the prosecution history.

42. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient.

43. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the patent specification, and the prosecution history are of paramount importance. Additionally, the

specification and prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

44. I understand that the claims of a patent define the scope of the rights conferred by the patent. The claims particularly point out and distinctly claim the subject matter which the patentee regards as his invention. Because the patentee is required to define precisely what he claims his invention to be, it is improper to construe claims in a manner different from the plain import of the terms used consistent with the specification. Accordingly, a claim construction analysis must begin and remain centered on the claim language itself. Additionally, the context in which a term is used in the challenged claim can be highly instructive. Likewise, other claims of the patent in question, both challenged and non-challenged, can inform the meaning of a claim term. For example, because claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

45. I understand that the claims of a patent define the purported invention. I understand that the purpose of claim construction is to understand how one

skilled in the art would have understood the claim terms at the time of the purported invention.

46. I understand that a person of ordinary skill in the art is deemed to read a claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification. For this reason, the words of the claim must be interpreted in view of the entire specification. The specification is the primary basis for construing the claims and provides a safeguard such that correct constructions closely align with the specification. Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim as set forth in the patent itself.

47. I understand that it is improper to place too much emphasis on the ordinary meaning of the claim term without adequate grounding of that term within the context of the specification of the challenged patent. Hence, claim terms should not be broadly construed to encompass subject matter that, although technically within the broadest reading of the term, is not supported when the claims are read in light of the invention described in the specification. Put another way, claim terms are given their broadest reasonable interpretation that is consistent with the specification and the prosecution history. Art incorporated by reference or

otherwise cited during the prosecution history is also highly relevant in ascertaining the breadth of claim terms.

48. I understand that the role of the specification is to describe and enable the invention. In turn, the claims cannot be of broader scope than the invention that is set forth in the specification. Care must be taken lest word-by-word definition, removed from the context of the patent, leads to an overall result that departs significantly from the patented invention.

49. I understand that claim terms must be construed in a manner consistent with the context of the intrinsic record. In addition to consulting the specification, one should also consider the patent's prosecution history, if available. The prosecution file history provides evidence of how both the Patent Office and the inventors understood the terms of the patent, particularly in light of what was known in the prior art. Further, where the specification describes a claim term broadly, arguments and amendments made during prosecution may require a more narrow interpretation.

50. I understand that while intrinsic evidence is of primary importance, extrinsic evidence, e.g., all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises, can also be considered. For example, technical dictionaries may help one better understand the underlying technology and the way in which one of skill in the art

might use the claim terms. Extrinsic evidence should not be considered, however, divorced from the context of the intrinsic evidence. Evidence beyond the patent specification, prosecution history, and other claims in the patent should not be relied upon unless the claim language is ambiguous in light of these intrinsic sources. Furthermore, while extrinsic evidence can shed useful light on the relevant art, it is less significant than the intrinsic record in determining the legally operative meaning of claim language.

51. I understand that in general, a term or phrase found in the introductory words of the claim, the preamble of the claim, should be construed as a limitation if it recites essential structure or steps, or is necessary to give life, meaning, and vitality to the claim. Conversely, a preamble term or phrase is not limiting where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention. In making this distinction, one should review the entire patent to gain an understanding of what the inventors claim they actually invented and intended to encompass by the claims.

52. I understand that language in the preamble limits claim scope (i) if dependence on a preamble phrase for antecedent basis indicates a reliance on both the preamble and claim body to define the claimed invention; (ii) if reference to the preamble is necessary to understand limitations or terms in the claim body; or (iii)

if the preamble recites additional structure or steps that the specification identifies as important.

53. I understand that an indefinite article "a" or "an" in patent parlance carries the meaning of "one or more" in open-ended claims containing the transitional phrase "comprising." I understand that, unless the claim is specific as to the number of elements, the article "a" receives a singular interpretation only in rare circumstances when the patentee evinces a clear intent to so limit the article, and thus, under this conventional rule, the claim limitation "a," without more, requires "at least one."

E. Legal Standard for Priority Date

54. I further understand that the "priority date" of a patent is the date on which it is filed, or the date on which an earlier-filed patent application is filed if the patentee properly claims the benefit of priority to that earlier-filed patent application. I further understand the priority date is used to determine the filing date of a patent for purposes of determining whether a reference qualifies as prior art under § 102(b).

55. I understand that a patentee is permitted to claim the benefit of priority to an earlier-filed application as a continuation, divisional, or continuation-in-part application. In order to properly claim the benefit of priority as a continuation or divisional application, I understand that the later-filed application

cannot include any material that would constitute new matter. Further, I understand that to properly claim the benefit of priority as a continuation-in-part application, only those claims in the later-filed application that find adequate written description and enablement in the earlier-filed application are entitled to the earlier-filed application's priority date. It is my understanding that written description and enablement are two different requirements that must both be satisfied to properly claim the benefit of an earlier priority date. Further, it is my understanding that conclusive evidence that one requirement is met is not equally conclusive evidence that the other has been met.

56. I understand that under the first of these requirements, the claims of the later-filed application must be supported by adequate written description in the earlier-filed application. I understand that adequate written description will describe the claimed invention in sufficient detail that a person of ordinary skill in the art would conclude that the patentee was in possession of what is claimed in the later-filed application at the time of the earlier-filed application. It is my understanding that one factor to consider is whether the earlier-filed application puts the public in possession of what is claimed in the later-filed application.

57. I understand that adequate written description is evaluated on a claim-by-claim basis. It is also my understanding that each claim limitation must find

adequate support in the earlier-filed application for a claim in the later-filed application to properly claim the benefit of the earlier priority date.

58. I further understand that the earlier-filed application must enable the claims of the later-filed application. I understand that a particular claim is enabled if, when filed, the earlier-filed application contained sufficient information to enable a person of ordinary skill in the art to make and use the invention claimed in the later-filed application. It is my understanding that a claim is enabled if a person of ordinary skill in the art could practice the claimed invention without undue or unreasonable experimentation. I understand that a determination of whether the amount of experimentation is "undue" considers several factors, including:

- the quantity of experimentation required to make or use the invention;
- the amount of direction or guidance presented;
- the presence of working examples, if any;
- the nature of the invention;
- the state of the prior art;
- the level of a person of ordinary skill;
- the level of predictability in the art; and
- the breadth of the claims.

59. However, I also understand that none of these factors is determinative, and that other factors can be considered as well. I understand that enablement is

evaluated as of the filing date of the later-filed application, and that the claims of the later-filed application are evaluated on a claim-by-claim basis.

III. Level of Skill of One of Ordinary Skill in the Art

60. In determining the characteristics of a hypothetical person of ordinary skill in the art of the ’774 Patent at the time of the claimed invention, I considered several things, including various prior art techniques relating to magnetic tape, the type of problems that such techniques gave rise to, and the rapidity with which innovations were made. I also considered the sophistication of the technologies involved, and the educational background and experience of those actively working in the field. I also considered the level of education that would be necessary to understand the ’774 Patent. Finally, I placed myself back in the relevant period of time, and considered the academics, engineers, and graduate students that I had worked with in the field of materials science and magnetic tape. I came to the conclusion that the characteristics of a person of ordinary skill in the field of art of the ’774 Patent would have been a person with (a) a bachelor’s degree in materials science, electrical engineering, mechanical engineering, chemistry, or a closely related field, and at least five years of experience—either in industry or academic research—relating to magnetic tape, or (b) a master’s degree or higher in materials science, electrical engineering, mechanical engineering, chemistry, or a closely related field, and at least three years of experience—either

in industry or academic research—relating to magnetic tape. A person with less education but more relevant practical experience, or more relevant education but less practical experience, may also meet this standard. Through my education and work experience, as well as my review of the literature and other publications available at the time, I am familiar with the ordinary level of skill in the art at the time of the alleged invention of the ’774 Patent.

IV. The ’774 Patent

A. Summary of the ’774 Patent

61. I have reviewed Ex. 1001, U.S. Patent No. 7,029,774 (“the ’774 Patent”). The ’774 Patent discusses various surface roughness measurements for the backcoat of magnetic tape. The claims recite measurements (skew, kurtosis, peak height mean, peak-to-valley roughness, and plateau ratio) falling within particular ranges but do not appear to recite any elements directed to the formulation of the tape or manufacturing technique for producing the tape. The claims of the ’774 Patent are reproduced in the following section.

62. The ranges of the surface topography parameters recited by the claims of the ’774 Patent are exceptionally broad. I have over a decade of experience measuring the surface topography of magnetic tape, in addition to many other surfaces, and in my opinion, a large number of prior art tapes in the 2003–2005 timeframe could have fallen in the scope of the claims, given their breadth. For

example, the claim 1 recites a "backside surface having a skew less than about 0.5 and a kurtosis less than about 4.0." This range encompasses almost any surface with basic Gaussian distribution of asperity heights, which by definition has a skew of 0 and kurtosis of 3. Many natural and random processes result in a surface topography with an asperity height distribution that is approximately Gaussian. The claimed ranges of skew less than 0.5 and kurtosis less than 4.0 encompass a broad swath of prior art tapes with a distribution of asperity heights that is relatively close to Gaussian—amongst many other surfaces. Similarly, the recited ranges for peak height mean, peak-to-valley-roughness, and plateau ratio likely encompass a broad range of prior art tapes.

B. '774 Patent Claims

63. I understand that Petitioner is challenging the validity of claims 1-13 and 15-20 of the '774 Patent in the Petition for *Inter Partes* Review. Claims 1, 15, and 20 are independent, while claims 2-13 depend on claim 1, and 16-19 depend on claim 15. These claims are set forth below:

(i) Claim 1

A magnetic recording medium comprising:

a substrate defining a first surface and a second surface opposite the first surface;

a magnetic side formed over the first surface of the substrate and defining a recording surface; and

a backside coated on the second surface of the substrate and configured to decrease embossment of the recording surface, the backside defining a backside surface opposite the substrate, the backside surface having a skew less than about 0.5 and a kurtosis less than about 4.0.

(ii) Claim 2

The magnetic recording medium of claim 1, wherein the magnetic side includes at least one layer, and the at least one layer includes a magnetic recording layer.

(iii) Claim 3

The magnetic recording medium of claim 1, wherein the backside surface has a peak height mean less than about 200 nm.

(iv) Claim 4

The magnetic recording medium of claim 1, wherein the backside surface has a peak-to-valley roughness less than about 325 nm.

(v) Claim 5

The magnetic recording medium of claim 4, wherein the peak-to-valley roughness is less than about 300 nm.

(vi) Claim 6

The magnetic recording medium of claim 1, wherein the backside surface has a plateau ratio of less than or equal to about 0.65.

(vii) Claim 7

The magnetic recording medium of claim 1, wherein the kurtosis value is less than or equal to about 3.7.

(viii) Claim 8

The magnetic recording medium of claim 1, wherein the magnetic recording medium has a skirt signal-to-noise ratio of greater than about 0.2 relative dB along a substantial entirety of a total length of the magnetic recording medium.

(ix) Claim 9

The magnetic recording medium of claim 1, wherein a first skirt signal-to-noise ratio measured at any first location along a total length of the magnetic recording medium varies from a second skirt signal-to-noise ratio measured at any second location along the total length of the magnetic recording medium by less than about 0.5 dB.

(x) Claim 10

The magnetic recording medium of claim 1, wherein the magnetic recording medium has a small error rate of less than about 0.5 errors/m along a substantial entirety of a total length of the magnetic recording medium.

(xi) Claim 11

The magnetic recording medium of claim 1, wherein a first small error rate measured at any first location along a total length of the magnetic recording medium varies from a second small error rate measured at any second location along the total length of the magnetic recording medium by less than about 0.25 error/m.

(xii) Claim 12

The magnetic recording medium of claim 1, wherein the backside includes a plurality of carbon black particles having an average size less than or equal to 30 nm.

(xiii) Claim 13

The magnetic recording medium of claim 12, wherein the plurality of carbon black particles have an average size less than or equal to 25 nm.

(xiv) Claim 15

A magnetic recording medium comprising:

a substrate defining a first surface and a second surface opposite the first surface;

a magnetic side coated on the first surface of the substrate and defining a recording surface; and

a backside coated on the second surface of the substrate and configured to decrease the embossment of the recording surface, wherein the backside defines a backside surface opposite the substrate, the backside surface having a peak height mean less than about 200 and a peak-to-valley roughness less than about 325 nm.

(xv) Claim 16

The magnetic recording medium of claim 15, wherein the backside surface has a skew less than about 0.5.

(xvi) Claim 17

The magnetic recording medium of claim 15, wherein the peak-to-valley roughness is less than about 300 nm.

(xvii) Claim 18

The magnetic recording medium of claim 15, wherein a first skirt signal-to-noise ratio measured at any first location along a total length of the magnetic recording medium varies from a second skirt signal-to-noise ratio measured at any second location along the total length of the magnetic recording medium by less than about 0.5 dB.

(xviii) Claim 19

The magnetic recording medium of claim 15, wherein a first small error rate measured at any first location along a total length of the magnetic recording medium varies from a second small error rate measured at any second location along the total length of the magnetic recording medium by less than about 0.25 error/m.

(xix) Claim 20

A magnetic recording medium comprising:

a substrate defining a first surface and a second surface opposite the first surface;

a magnetic side coated on the first surface of the substrate and defining a recording surface; and

a backside coated on the second surface of the substrate and configured to decrease the embossment of the recording surface, wherein the backside defines a backside surface opposite the substrate, the backside surface having a skew less than about 0.5, a kurtosis less than about 4.0, a peak height mean of less than about 200, and a peak-to-valley roughness less than about 325 nm.

V. Claim Construction

64. For purposes of this *Inter Partes* Review I have considered the claim language, specification, and portions of the prosecution history, to determine the meaning of the claim language as it would have been understood by a person of ordinary skill in the art at the time of the invention.

A. "skew"

65. Under BRI, a person of ordinary skill in the art would have understood this term, used in claims 1, 16, and 20, to at least include "an R_{sk} measurement from an optical interferometer trace." The specification expressly states that "the values used throughout this application were measured using a

Wyko® Optical Interferometer" including "skew, peak height mean, peak-to-valley roughness, plateau ratio, and kurtosis." Ex. 1001 col. 8:2-12. The specification further defines "Skew" as a measurement of "R_{sk}." *Id.* col. 8:13. Thus, a POSITA would have understood that "skew" as used in the '774 Patent would at least include "an R_{sk} measurement from an optical interferometer trace."

66. A POSITA would have recognized that optical interferometers, including Wyko® brand optical interferometers, can be configured to display R_{sk} measurements, and that such R_{sk} measurements were consistent with the understanding of R_{sk} in the field. R_{sk} is a term of art referring to the third moment of a surface topography distribution sampled over a trace (i.e., a line) along the surface. *See, e.g.*, Ex. 1016 ("ISO 4287") at 22. For decades, the International Standardization Organization (ISO) has been one of the preeminent standardization bodies in the world, and its standards were widely referred to in the industry. ISO 4287 discloses definitions for numerous topography measurements including "*Rsk*," "*Rku*," and "*Rz*." Ex. 1016 at 20, 22. ISO 4287 illustrates the surface profile being measured as the "profile that results from the intersection of the real surface by a specified plane." Ex. 1016 at 11.

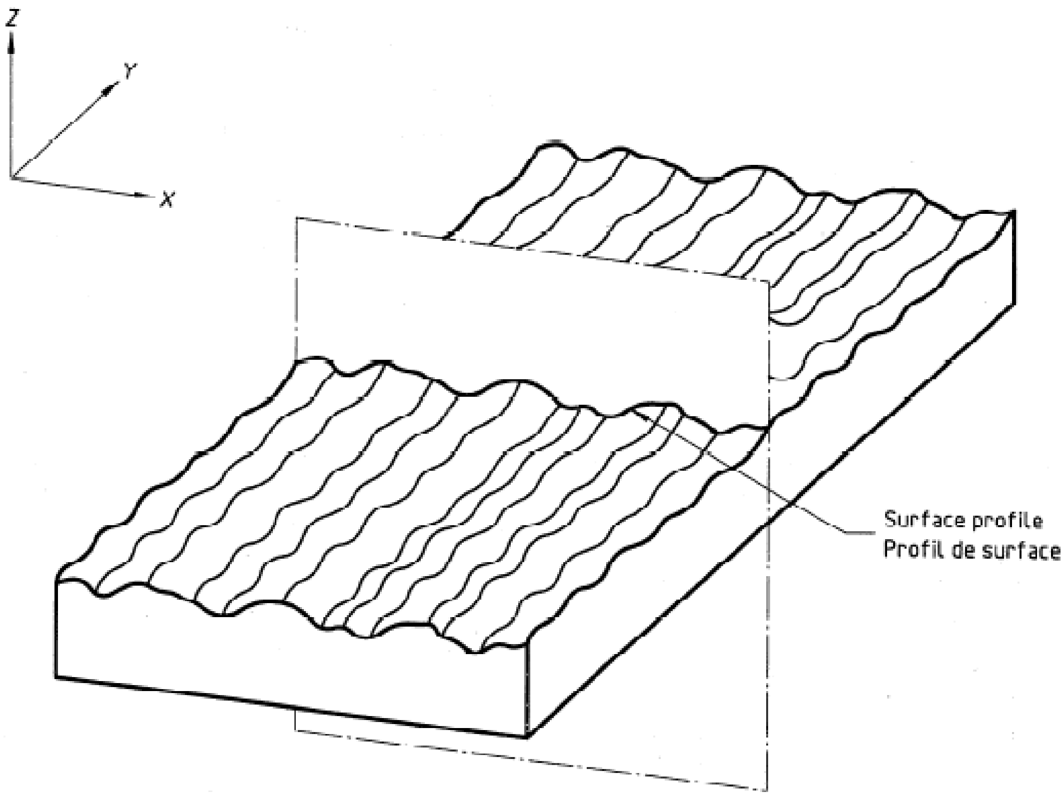


Figure 2 — Surface profile
Figure 2 — Profil de surface

Id.

67. The ISO 4287 definition for R_{sk} corresponds with the meaning of R_{sk} that I explained above; it calculates the third moment of the surface topography distribution sampled over a trace ("within a sampling length," as stated by ISO 4287 in a single x dimension). *See* Ex. 1016 at 22. The ISO 4287 definition is shown below:

$$Rsk = \frac{1}{Rq^3}\left[\frac{1}{lr}\int_0^{lr} Z^3(x)\,dx\right]$$

Ex. 1016 at 22. In that definition *Z*(*x*) is the surface profile sampled over a trace, *lr* is the length of the trace, and R_q is the root mean square (RMS) roughness. This corresponds with the R_{sk} measurement obtained from optical interferometers, including Wyko® and Zygo® brands.

68. On March 27, 2017, I went to the library of the University of Utah and requested a copy of ISO 4287-1997. On March 29, 2017, the University library sent me Ex. 1016, which is a copy of ISO 4287-1997. I believe I saw ISO 4287-1997 in the second half of 2004, and in my opinion, it was not new when I first saw it and had had existed for years before. In fact, ISO standards typically contain a publication date. Ex. 1016 contains a publication date of April 1, 1997. Ex. 1016 at 1. I believe ISO 4287-1997 was published April 1, 1997, and thus will be at least 20 years old by April 2017. *See id.* A library is a place where authentic copies of ISO standards would be located. Nothing about Ex. 1016 gave me any suspicion about its authenticity. It is my understanding that redactions were applied to irrelevant pages of Ex. 1016 out of respect for its copyright.

B. "kurtosis"

69. Under BRI, a person of ordinary skill in the art would have understood this term, used in claims 1, 7, and 20, to at least include "an R_{ku} measurement from an optical interferometer trace." The specification expressly states that "the values used throughout this application were measured using a

Wyko® Optical Interferometer" including "kurtosis." Ex. 1001 col. 8:2-12. The specification further defines "Kurtosis" as a measurement of "R_{ku}." *Id.* col. 8:65. Thus, a POSITA would have understood that "kurtosis" as used in the '774 Patent would at least include "an R_{ku} measurement from an optical interferometer trace."

70. A POSITA would have recognized that optical interferometers, including Wyko® brand optical interferometers, can be configured to display R_{ku} measurements, and that such R_{ku} measurements were consistent with the understanding of R_{ku} in the field. R_{ku} is a term of art referring to the fourth moment of a surface topography distribution sampled over a trace (i.e., a line) along the surface. *See* Ex. 1016 at 22. ISO 4287 discloses a definition for "R_{ku}" based on the surface "profile that results from the intersection of the real surface by a specified plane." Ex. 1016 at 11, 22, Figure 2.

71. The ISO 4287 definition for R_{ku} corresponds with the meaning of R_{ku} that I explained above; it calculates the fourth moment of the surface topography distribution sampled over a trace ("within a sampling length," as stated by ISO 4287 in a single *x* dimension). *See* Ex. 1016 at 22. The ISO 4287 definition is shown below:

$$Rku = \frac{1}{Rq^4}\left[\frac{1}{lr}\int_0^{lr} Z^4(x)\,\mathrm{d}x\right]$$

Ex. 1016 at 22. In that definition *Z*(*x*) is the surface profile sampled over a trace, *lr* is the length of the trace, and R_q is the RMS roughness. This corresponds with the R_{ku} measurement taken by optical interferometers, including Wyko® and Zygo® brands.

C. "peak height mean"

72. A POSITA would have understood this term, used in claims 3, 15, and 20, to at least include "an R_{pm} measurement from an optical interferometer trace." The specification expressly states that "the values used throughout this application were measured using a Wyko® Optical Interferometer" including "peak height mean." Ex. 1001 col. 8:2-12. The specification further defines "Peak Height Mean" as a measurement of "R_{pm}." *Id.* col. 8:65. Thus, a POSITA would have understood that "peak height mean" as used in the '774 Patent would at least include "an R_{pm} measurement from an optical interferometer trace."

73. A POSITA would have recognized that optical interferometers, including Wyko® brand optical interferometers, can be configured to display R_{pm} measurements, and that such R_{pm} measurements were consistent with the understanding of R_{pm} in the field. R_{pm} is a term of art referring to the mean height of peaks along a trace.

74. Though claims 3, 15, and 20 do not expressly state units, a person of ordinary skill in the art would have understood this term to refer to nm because of

the extremely smooth finish of the tape front and back surface; this is consistent with the language of dependent claim 3 ("[T]he backside surface has a peak height mean less than about 200 nm") as well as the specification. Ex. 1001 at 8:36-37 ("In one embodiment, the peak height mean of the magnetic recording medium 30 is less than about 200 nm."). Table 1 of the '774 Patent discloses a "Peak Mean Height (R_{pm})," measured in nm, which a person of ordinary skill in the art would have understood to also mean a "peak height mean." Ex. 1001 at 10:7-8 (Table 1).

D. "peak-to-valley roughness"

75. A POSITA would have understood this term, used in claims 4, 5, 15, 17, and 20, to at least include "an R_z measurement from an optical interferometer trace." The specification expressly states that "the values used throughout this application were measured using a Wyko® Optical Interferometer" including "peak-to-valley roughness." Ex. 1001 col. 8:2-12. The specification further defines "Peak-to-Valley Roughness" as a measurement of "R_z." *Id.* col. 8:65. Thus, a POSITA would have understood that "peak-to-valley roughness" as used in the '774 Patent would at least include "an R_z measurement from an optical interferometer trace."

76. A POSITA would have recognized that optical interferometers, including Wyko® brand optical interferometers, can be configured to display R_z measurements, and that such R_z measurements were consistent with the

understanding of R_z in the field. R_z is a term of art measuring peak-to-valley separations along a trace. *See* Ex. 1016 at 20. ISO 4287 discloses a definition for "R_z" based on the surface "profile that results from the intersection of the real surface by a specified plane." Ex. 1016 at 11, 22, Figure 2. The ISO 4287 definition for R_z corresponds with the R_z measurement taken by optical interferometers, including Wyko® and Zygo® brands.

E. "plateau ratio"

77. A POSITA would have understood this term, used in claim 6, to at least include "a ratio of $\frac{R_{pm}}{R_z}$ measurements, where R_{pm} is peak height mean and R_z is peak-to-valley roughness." The specification provides this definition explicitly. Ex. 1001 col. 8:55.

F. "the backside surface having a skew less than about 0.5"; "the backside surface having ... a kurtosis less than about 4.0"; "the backside surface has a peak height mean less than about 200 nm"; "the backside surface has a peak-to-valley roughness less than about 325 nm"; "the backside surface has a plateau ratio of less than or equal to about 0.65"

78. Under BRI, a POSITA would have understood "skew," "kurtosis," "peak height mean," "peak-to-valley roughness," and "plateau ratio" to at least include, respectively, an "R_{sk}," "R_{ku}," "R_{pm}," "R_z," or "R_{pm}/R_z" measurement from an optical interferometer trace. *See supra* Sections V.A-E. Thus, a POSITA would have understood these broader elements, under BRI, to be satisfied by "at least one" such measurement for each recited range:

- "the backside surface having at least one R_{sk} measurement less than about 0.5";
- "the backside surface having at least one R_{ku} measurement less than about 4.0";
- "the backside surface has at least one R_{pm} measurement less than about 200 nm";
- "the backside surface has at least one R_z measurement less than about 325 nm";
- "the backside surface has at least one R_{pm}/R_z ratio of less than or equal to about 0.65," i.e., "the backside surface has a ratio of at least one measurement of R_{pm} divided by at least one measurement of R_z less than or equal to about 0.65."

See supra Sections V.A-E.

79. It is my understanding that, in patent parlance, the claim limitation "a," without more, merely requires "at least one." *See supra* ¶53. Here, the claims do not recite an average of multiple measurements, state that all measurements must be within their respective ranges, or specify any particular number of measurements that must be taken. *See* Ex. 1001 col. 12:50-14:42. Instead, the '774 Patent simply describes each measurement using their respective R-notation measurements and recites "the backside surface having **a** [measurement] less than

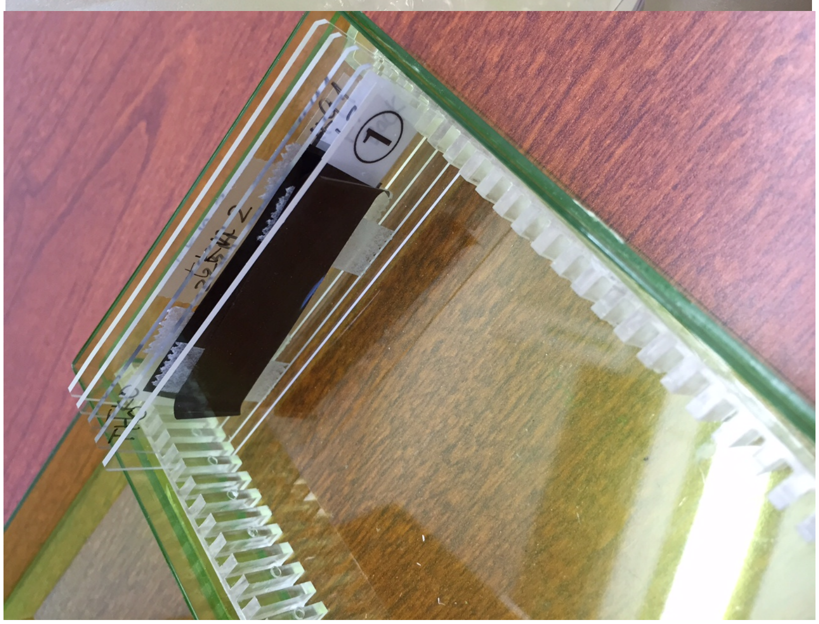
about [the claimed value].” *See* Ex. 1001 col. 12:50-14:42 (emphasis added); *supra* Sections V.A-E. Under BRI, a POSITA would have understood this claim language to be satisfied if the backside surface has at least one R_{sk}, R_{ku}, R_{pm}, R_z, or R_{pm}/R_z measurement falling within the respectively claimed ranges. *See id.*

VI. Tape Samples

A. Receipt of the Tape Samples

80. On 10 March 2017, I received a FedEx package from Norihito Kasada containing three strips of magnetic tape mounted to glass slides. Attachments B and C are the tracking sheets I received with this shipment.

81. The tape samples were labeled Sample 1-3. The below photographs show the tape samples packaged as I received them. I removed the tape samples from their container and performed the measurement without altering the tape.



82. As explained below, I performed measurements on the tape samples to determine whether the tape samples satisfy the surface topology specifications recited in the claims of the ’774 Patent. Throughout the measurements that I performed, I referred to the tape samples according to the labels attached to the glass slides as I received them. When I performed the measurements discussed

below, I was not informed or aware of any manufacturing or formulation differences between the tapes. The measurements were performed as a blind test.

B. Measurement Procedure

83. I measured the surface parameters of each tape sample using a Zygo NewView 5000 5032 optical surface profiler available for use to my lab, and maintained by the University of Utah, College of Engineering, Surface Analysis and Microscopy Suite. Zygo is a manufacturer and brand of optical profilers and is well-known in the industry. A Zygo optical profiler uses white light interferometry to measure topography, and quantify surface topography metrics. WYKO, as referred to by the ’774 Patent, is another common brand of optical profilers (optical interferometers). *See* Ex. 1001 col. 8:8-10 (“values used throughout this application were measured using a Wyko® Optical Interferometer”). There is no significant difference between a Zygo optical profiler and a WYKO optical profiler in terms of the measurements produced. A Zygo brand optical surface profiler generates surface topography measurements that are comparable to the measurements generated by a WYKO optical profiler, as both devices are based on the same physical principles, and measurement methodology. WYKO and Zygo optical profilers can similarly be configured to report R_{sk}, R_{ku}, R_{pm}, and R_z, measurements. In the field of magnetic tape, this test procedure—i.e., the use of

WYKO and Zygo optical profilers for measuring R_{sk}, R_{ku}, R_{pm}, R_z, and plateau ratio—is regarded as a standard practice that is commonly used in the field.

84. The ’774 Patent also states that its measurements may be performed “using a Wyko® Optical Profiler manufactured by Veeco Instruments, Inc. of Tucson, Ariz., or other suitable device.” Ex. 1001 col. 8:4-7. A POSITA would have understood that a Zygo is another common brand of optical profilers and thus one of the “suitable devices” disclosed by the ’774 Patent. *See id.*

85. I measured the surface topography of each tape sample at multiple locations on the tape. Taking each measurement involved placing a steel washer around the measurement spot prior to performing the measurement, to reduce the impact of any wrinkling or curvature of the tape, which can otherwise cause inconsistencies in the measurement results. I used an evaluation window of (W = 340 µm, L = 450 µm). This was a typical window size for evaluating tape of this sort. A trace measurement of the surface topography across the middle of the window of the testing field, in the tape lengthwise direction, was determined from the optical profiler measurement. At each location, I used the Zygo to measure R_{sk}, R_{ku}, R_{pm}, and R_z, taking the number reported by the Zygo machine. I then calculated plateau ratio as $\frac{R_{pm}}{R_z}$ based on the R_{pm} and R_z at the measurement location.

C. Measurement Results

86. The table below contains measurements that I took for tape samples 1-3. I took measurements at up to 3 locations for each tape sample. The particular surface characteristics are the same ones referred to by U.S. Patent No. 7,029,774, including skew (R_k), kurtosis (R_{ku}), peak height mean (R_{pm}), peak-to-valley roughness (R_z), and plateau ratio (R_{pm}/R_z). These values were measured and calculated from the surface topography measured from the tape samples.

Table 1: Measurement Results

	Sample 1		Sample 2			Sample 3		
Location	1	2	1	2	3	1	2	3
Skew (R_{sk})	0.4	0.3	0.32	0.24	-0.03	4.44	0.42	5.59
Kurtosis (R_{ku})	2.91	3.39	3.3	3.51	2.52	72.07	3.46	70.89
Peak Height Mean (R_{pm}) (nm)	13	13	13	15	14	61	20	45
Peak-to-Valley Roughness (R_z) (nm)	25	26	25	28	25	106	34	59
Plateau Ratio (R_{pm}/R_z)	0.52	0.5	0.52	0.54	0.56	0.58	0.59	0.76

D. Conclusions

87. As shown in Table 1, the skew (R_k), kurtosis (R_{ku}), peak height mean (R_{pm}), peak-to-valley roughness (R_z), and plateau ratio (R_{pm}/ R_z) measurements recited in the ’774 Patent claims are met by Tape Samples 1-3. Several claims

recite the element "the backside surface having a skew less than about 0.5." This is satisfied by all three tape samples, each of which had at least one R_{sk} measurement of less than 0.5 from an optical interferometer trace. *See* Table 1 (Tape Sample 1 Locations 1-2, Tape Sample 2 Locations 1-3, Tape Sample 3 Location 2).

88. Several claims recite the element "the backside surface having … a kurtosis less than about 4.0." This is satisfied by all three tape samples, each of which had at least one R_{ku} measurement of less than 4.0 from an optical interferometer trace. *See* Table 1 (Tape Sample 1 Locations 1-2, Tape Sample 2 Locations 1-3, Tape Sample 3 Location 2). Some claims further require that "the kurtosis value is less than or equal to about 3.7." All three tapes (Tape Sample 1 Locations 1-2, Tape Sample 2 Locations 1-3, and Tape Sample 3 Location 2) satisfy this requirement. *See* Table 1.

89. Several claims recite the element "the backside surface has a peak height mean less than about 200 nm." This is satisfied by all three tape samples, each of which had at least one R_{pm} measurement of less than 200 nm from an optical interferometer trace. *See* Table 1 (all measurements for all Tape Samples).

90. Several claims recite the element "the backside surface has a peak-to-valley roughness less than about 325 nm." This is satisfied by all three tape samples, each of which had at least one R_z measurement of less than 325 nm from an optical interferometer trace. *See* Table 1 (all measurements for all Tape

Samples). Other claims further require that "the peak-to-valley roughness is less than about 300 nm." This limitation is met by all measurements for all Tape Samples, which display R_z measurements between 25-106 nm. *See* Table 1.

91. Several claims recite the element "the backside surface has a plateau ratio of less than or equal to about 0.65." This is satisfied by all three tape samples, each of which had at least one R_{pm}/R_z ratio of less than or equal to about 0.65, i.e., a ratio of at least one measurement of R_{pm} divided by at least one measurement of R_z less than or equal to about 0.65. *See* Table 1 (Tape Sample 1 Locations 1-2, Tape Sample 2 Locations 1-3, Tape Sample 3 Locations 1-2).

92. The measurements at Locations 1 and 3 of Tape Sample 3 were, in my opinion, outliers, possible caused by a local surface defect due to tape cutting, mounting, or handling and shipping. A POSITA with experience measuring surface roughness on tape would have recognized these as likely outlier points. Regardless, the elements discussed above merely require "at least one" measurement in the claimed ranges, and for each measurement recited in the claims of the '774 Patent, Tape Sample 3 had at least one measurement in the claimed ranges: Location 2 for skew (R_k) and kurtosis (R_{ku}), all locations for peak height mean (R_{pm}) and peak-to-valley roughness (R_z), and Locations 1-2 for plateau ratio (R_{pm}/ R_z).

93. In short, each of the surface topography measurements recited in the claims of the ’774 Patent are met by each of Tape Samples 1-3.

VII. Declaration

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. I hereby declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code.

Executed on April 11, 2017.

Bart Raeymaekers
____
DR. BART RAEYMAEKERS

ATTACHMENT A

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INTERESTS

Tribology, precision manufacturing, mechanical design, entrepreneurship

ACADEMIC EMPLOYMENT

Associate Professor (tenured), University of Utah **July 2016 – Present**
Department of Mechanical Engineering
Co-founder, University of Utah Manufacturing Extension Partnership Center **October 2016 – Present**
Department of Mechanical Engineering
Assistant Professor (tenure-track), University of Utah **October 2010 – June 2016**
Department of Mechanical Engineering
Post-Doctoral Fellow, Los Alamos National Laboratory **October 2009 – October 2010**
Mentor: Dr. Dipen N. Sinha
Post-Doctoral Researcher, University of California San Diego **June 2009 – October 2009**
Advisor: Professor Frank E. Talke

EDUCATION

PhD Engineering Sciences (Mechanical Engineering), **University of California San Diego** **2007**
Advisor: Professor Frank E. Talke

MS Engineering Sciences (Mechanical Engineering), **University of California San Diego** (summa cum laude) **2005**

MSc Applied Sciences (Electromechanical Engineering), **Vrije Universiteit Brussel, Belgium** (magna cum laude) **2004**

BSc Electromechanical Engineering, **KaHo St. Lieven, Ghent, Belgium** (magna cum laude) **2002**

ADDITIONAL EDUCATION

MBA Entrepreneurship/Finance, **Massachusetts Institute of Technology** (Sloan School of Management) **2009**

AWARDS AND FELLOWSHIPS

- Department of Mechanical Engineering, University of Utah, Outstanding Researcher Award 2015
- Department of Mechanical Engineering, University of Utah, Outstanding Teaching Award 2014-2015
- ASME Burt L. Newkirk Award for notable contributions in the field of tribology (2014)
- ASME Information Storage & Processing Systems Conference best paper award, Santa Clara, CA (2014)
- Department of Mechanical Engineering, University of Utah, Outstanding Teaching Award 2013-2014
- College of Engineering, University of Utah, top 15% undergraduate instructor, ME EN 5620 (fall 2012)
- College of Engineering, University of Utah, top 15% graduate instructor, ME EN 6620 (fall 2012)
- College of Engineering, University of Utah, top 15% graduate instructor, ME EN 6960 (fall 2011)
- ASME Information Storage & Processing Systems Conference best paper award, Santa Clara, CA (2008)
- Sheldon Schultz Prize for Excellence in Graduate Student Research, Center for Magnetic Recording Research, University of California San Diego (2007)
- Dissertation Fellowship, Department of Mechanical and Aerospace Engineering, University of California San Diego (2007)
- Barbara J. and Paul D. Saltman Excellent Teaching Award, University of California San Diego (2006) (for being a teaching assistant in MAE 150, MAE 156B)
- ASME Information Storage & Processing Systems Division, Graduate Student Fellowship (2006)
- Outstanding Teaching Assistant Award, Department of Mechanical and Aerospace Engineering, University of California San Diego (2006)
- Outstanding Graduate Student Award, Department of Mechanical and Aerospace Engineering, University of California San Diego (2006)
- Fellow, Belgian American Educational Foundation (B.A.E.F.) (2004)
- Fellow, Francqui Foundation (2004)

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B33. Noble BA, Raeymaekers B, Spreading kinetics of ultra-thin polymer-based lubricant films using molecular dynamics; *Proc. of* STLE Annual Meeting, Atlanta, GA (USA), 21-25 May 2017
B32. Mate CM, Noble BA, Raeymaekers B, Anomalous spreading kinetics of polymer lubricant films, *Proc. of* 253rd National Meeting of the American Chemical Society, San Francisco, CA (USA), 2-6 April 2017
B31. Greenhall JJ, Guevara Vasquez F, Raeymaekers B, Unconstrained manipulation of micro-particles using phase-control of standing ultrasound wave fields, *Proc. of* 5th Joint Meeting of the Acoustical Society of America and the Acoustical Society of Japan, Honolulu, HI (USA), 28 November - 2 December 2016
B30. Greenhall JJ, Guevara Vasquez F, Raeymaekers B, Ultrasound directed self-assembly of user-specified patterns of nanoparticles dispersed in a fluid medium, *Proc. of* 171st ASA Conference, Salt Lake City, UT (USA), 23-27 May 2016
B29. Price MR, Ovcharenko A, Raeymaekers B, Determining mechanical properties of ultra-thin multi-layer coatings using nanoindentation simulations, *Proc. of* STLE Tribology Frontiers Conference, Denver, CO (USA), 25-27 October 2015
B28. Noble BA, Ovcharenko A, Raeymaekers B, Terraced spreading of nanometer-thin lubricant using molecular dynamics; *Proc. of* STLE Tribology Frontiers Conference, Denver, CO (USA), 25-27 October 2015
B27. Noble BA, Ovcharenko A, Raeymaekers B, Quantifying lubricant droplet spreading on a flat substrate using molecular dynamics; *Proc. of* STLE Annual Meeting, Dallas, TX (USA), 17-21 May 2015
B26. Price MR, Ovcharenko A, Thangaraj R, Raeymaekers B, Simulating nano-indentation of ultra-thin diamond-like carbon coatings, *Proc. of* STLE Tribology Frontiers Conference, Chicago, IL (USA), 26-28 October 2014
B25. Price MR, Ovcharenko A, Thangaraj R, Raeymaekers B, Delamination of ultra-thin diamond-like carbon coatings on magnetic recording heads under combined loading; *Proc. of* Information Storage and Processing Systems (ISPS) Conference, Santa Clara, CA (USA), 23-24 June 2014
B24. Qiu M, Raeymaekers B, Improving tribological performance of prosthetic knee joints using surface microtexturing; *Proc. of* STLE Annual Meeting, Lake Buena Vista, FL (USA), 18-22 May 2014
B23. Qiu M, Raeymaekers B, A patterned microtexture to improve longevity of prosthetic knee joints; *Proc. of* 2nd International Conference on Biotribology, Toronto (Canada), 11-14 May 2014
B22. Sanders AP, Weisenburger J, Haider H, Lockard C, Raeymaekers B, Using a surrogate contact pair to evaluate UHMWPE wear in knee condyle applications; *Proc. of* 6th UHMWPE meeting, Torino (Italy), October 2013

B21. Price MR, Ovcharenko A, Thangaraj R, Raeymaekers B, Quantifying delamination of ultra-thin diamond-like carbon coatings using molecular dynamics; *Proc. of* Science of Engineering (SES) Conference, Contact Mechanics Symposium, Providence, RI (USA), 28-31 July 2013

B20. Petersen SJ, Raeymaekers B, Basu S, Francoeur M, Infrared characterization of Mie resonance-based dielectric metamaterials fabricated using directed self-assembly; *Proc. of* IMECE, San Diego, CA (USA), 15-21 November 2013

B19. Price MR, Ovcharenko A, Thangaraj R, Raeymaekers B, Delamination of ultra-thin diamond-like carbon coatings on magnetic recording heads under normal loading; *Proc. of* Information Storage and Processing Systems (ISPS) Conference, Santa Clara, CA (USA), 24-25 June 2013

B18. Chyr A, Sanders AP, Raeymaekers B, Improving durability of metal-on-polyethylene hip joints using surface microtexturing; *Proc. of* STLE Annual Meeting, Detroit, MI (USA), 5-9 May 2013

B17. Chyr A, Sanders A, Raeymaekers B, Creating hydrodynamic lubrication in metal-on-polyethylene hip joints using microtexture; *Proc. of* Orthopedics Research Society Annual Meeting, San Antonio, TX (USA), 26-29 January 2013

B16. Qiu M, Bailey B, Stoll R, Raeymaekers B, The validity of the compressible Reynolds equation for gas lubricated textured parallel slider bearings; *Proc. of* ASME/STLE International Joint Tribology Conference, Denver, CO (USA), 8-10 October 2012

B15. Qiu M, Raeymaekers B, Performance of different microtexture shapes for textured gas lubricated parallel slider bearings; *Proc. of* ASME/STLE International Joint Tribology Conference, Denver, CO (USA), 8-10 October 2012

B14. Pawar G, Pawlus P, Etsion I, Raeymaekers B, The validity of the spectral moments approach and the Greenwood-Williamsion model for three-dimensional contacting rough surfaces; *Proc. of* STLE Annual Meeting, St. Louis, MO (USA), 6-10 May 2012

B13. Raeymaekers B, Pantea C, Sinha DN, Manipulating 5 nm diamond nanoparticles in user-defined patterns using bulk acoustic waves; *Proc. of* 161st ASA Conference, Seattle, WA (USA), 23-27 May 2011

B12. Raeymaekers B, Pantea C, Osterhoudt CF, Sinha DN, Ultrasonic imaging and characterization of objects submerged in highly attenuating fluids; *Proc. of 159th ASA* Conference, Baltimore, MD (USA), 19-22 April 2010

B11. Raeymaekers B, Helm S, Brunner R, Fanslau E, Talke FE, Fretting wear between a hollow sphere and a flat plate; *Proc. of* ASME/STLE International Joint Tribology Conference, Memphis, TN (USA), 19-21 October 2009

B10. Boettcher U, Raeymaekers B, de Callafon RA, Talke FE, Design of a dual-stage actuator tape head controller; *Proc. of* Information Storage and Processing Systems (ISPS) Conference, Santa Clara, CA (USA), 16-17 June 2008

B9. Boettcher U, Raeymaekers B, de Callafon RA, Talke FE, Design of a dual-stage actuator tape head controller; *Proc. of* ASME Engineering Systems Design and Analysis Conference, Haifa (Israel), 07-08 July 2008

B8. Raeymaekers B, Etsion I, Talke FE, A model for the magnetic tape/guide interface with laser surface texturing; *Proc. of* ASME/STLE International Joint Tribology Conference, San Diego, CA (USA), 22-24 October 2007

B7. Raeymaekers B, Etsion I, Talke FE, Reducing the magnetic tape/guide friction coefficient by laser surface texturing: Experimental Analysis; *Proc. of* ASME/STLE International Joint Tribology Conference, San Diego, CA (USA), 22-24 October 2007

B6. Raeymaekers B, Graham MR, de Callafon RA, Talke FE, Design of a dual-stage actuator tape head with high-bandwidth track-following capability; *Proc. of* Information Storage and Processing Systems (ISPS) Conference, Santa Clara, CA (USA), 18-19 June 2007

B5. Lee DE, Raeymaekers B, Talke FE , In-situ monitoring of the brush/rotor interface in a homopolar motor with acoustic emission; *Proc. of* AUSTRIB 06 Conference, Brisbane (Australia), 3-6 December 2006

B4. Raeymaekers B, Talke FE , The effect of friction between a cylindrical guide and magnetic tape on lateral tape motion; *Proc. of* AUSTRIB 06 Conference, Brisbane (Australia), 3-6 December 2006

B3. Raeymaekers B, Etsion I, Talke FE , Influence of operation conditions on tape/guide friction; Proc. of ASME/STLE International Joint Tribology Conference, San Antonio, TX (USA), 23-25 October 2006

B2. Raeymaekers B, Talke FE , The use of acoustic emission for detection of tape edge contact; Proc. of Micromechatronics for Information and Precision Equipment (MIPE) Conference, Santa Clara, CA (USA), 21-23 June 2006

B1. Raeymaekers B, Taylor RJ, Talke FE, Correlation of lateral tape motion and tape tension transients; Proc. of Information Storage and Processing Systems (ISPS) Conference, Santa Clara, CA (USA), 28-29 June 2005

PATENTS

C2. US Patent Application # PCT/US13/49115, Texturing of orthopedic knee and hip implants to improve durability, Raeymaekers B, Sanders A. Patent application filed on 07/02/2013 by University of Utah

C1. US Patent 8,722,155, Method to manufacture bit patterned magnetic recording media, Raeymaekers B, Pantea C, Sinha DN. Assignee: Los Alamos National Security, LLC.

CURRENT FUNDED RESEARCH PROGRAMS

National Science Foundation, MME, 07/15/2017 – 07/14/2020, $351,598 (Raeymaekers portion $100,000)
PI: Steven Naleway
Co-PI: Bart Raeymaekers

Title: Manufacturing of engineered materials with user-specified microstructures using freeze casting and ultrasound directed self-assembly

National Institute of Standards and Technology/Department of Commerce, MEP program, 10/01/2016 – 09/30/2021, $16,100,000 (Raeymaekers portion $12,100,000)
PI: Bart Raeymaekers
Co-PI: Bruce Gale
Title: University of Utah manufacturing extension partnership center

Department of Defense, Office of Economic Adjustment 10/01/2016 – 06/30/2018, $310,000
PI: Bart Raeymaekers
Title: Utah Advanced Materials Manufacturing Initiative, Supply-chain mapping

Army Research Office, Synthesis and Processing of Materials, 06/15/2016 – 06/14/2019, $394,236
PI: Bart Raeymaekers
Title: Synthesis of multi-functional materials with tailored properties using scalable ultrasound directed self-assembly and additive manufacturing

National Science Foundation, MME, 08/15/2016 – 08/14/2018, $100,000
PI: Bart Raeymaekers
Title: Additive Manufacturing of Bulk Engineered Materials with Tailored Properties

National Aeronautics and Space Administration, 08/01/2015 – 07/31/2019, $247,724
PI: Bart Raeymaekers
Title: Reinforcement of 3D printed nanocomposite materials using ultrasound alignment of carbon nanotubes

Department of Energy, National Nuclear Security Administration, 09/01/2015 – 08/31/2019, $190,376
PI: Bart Raeymaekers
Title: Nanoscale mechanics of polymer-based ultra-thin lubricant films

National Institutes of Health, NIAMS, 08/15/2015 – 08/14/2018, $223,358 (Raeymaekers portion $223,358)
PI: Bart Raeymaekers
Co-I: Roy D. Bloebaum
Title: Microtextured prosthetic hip joint to improve longevity

COMPLETED FUNDED RESEARCH PROGRAMS

National Science Foundation, 08/15/2012 – 01/31/2016, $174,252
PI: Bart Raeymaekers
Title: Patterned microtexture to create fluid film lubrication at low sliding velocities in prosthetic knee joints

Western Digital Corporation, 09/01/2014 – 08/31/2015, $50,000
PI: Bart Raeymaekers
Title: Molecular dynamics study of atomic wear of thin amorphous diamond-like carbon coatings (Part 3)

Army Research Office, 09/01/2014 – 06/01/2015, $49,883
PI: Bart Raeymaekers
Title: Scalable directed self-assembly using ultrasound

University of Utah Technology Commercialization Office, 05/15/2013 – 12/31/2014, $24,000 (Raeymaekers portion $8,000)
Technology Commercialization Project
PI: Bart Raeymaekers
Co-PI: Jake Abbott, Balamurali Ambati
Title: Design of cataract surgical knife (Part 2)

University of Utah Research Foundation, 01/01/2013 – 12/31/2014, $28,000 (Raeymaekers portion $27,000)
Seed Project
PI: Bart Raeymaekers
Co-PI: Daniel O. Adams
Title: Aligning carbon nanotubes using ultrasound to reinforce carbon composites

W.M. Keck Foundation, 01/01/2013 – 12/31/2014, $200,000 (Raeymaekers portion $0, development office)
PI: Ian Harvey
Co-PI: Bart Raeymaekers, Brian Baker, Bruce Gale, Tim Dallas (Texas Tech University)
Title: Educating undergraduate students in scaling phenomena in microscale engineering

National Science Foundation MRSEC Seed Project, 12/01/2012 – 06/30/2014, $30,000 (Raeymaekers portion $15,000)
National Science Foundation MRSEC University of Utah
PI: Mathieu Francoeur
Co-PI: Bart Raeymaekers
Title: Design, fabrication and characterization of Mie resonance-based three- dimensional isotropic metamaterials for tuning thermal radiative properties

National Institutes of Health, **NIAMS,** 09/18/2012 - 2/01/2014, $150,000 (Raeymaekers portion $58,430)
R41 STTR Phase 1 (with Mound Laser and Photonics Center, Kettering, OH)
PI: Ronald Jacobsen (MLPC)
Co-I: Bart Raeymaekers
Title: Patterned microtexture for improved durability of orthopedic knee implants

Western Digital Corporation, 09/01/2013 – 08/31/2014, $50,000
PI: Bart Raeymaekers
Title: Molecular dynamics study of atomic wear of thin amorphous diamond-like carbon coatings (Part 2)

Western Digital Corporation, 09/01/2012 – 08/31/2013, $50,000
PI: Bart Raeymaekers
Title: Molecular dynamics study of atomic wear of thin amorphous diamond-like carbon coatings (Part 1)

University of Utah Technology Commercialization Office, 01/01/2013 – 05/15/2013, $32,000 (Raeymaekers portion $10,667)
Technology Commercialization Project
PI: Bart Raeymaekers
Co-PI: Jake Abbott, Balamurali Ambati
Title: Design of cataract surgical knife (Part 1)

University of Utah Technology Commercialization Office, 12/01/2011 – 11/30/2012, $35,000 (Raeymaekers portion $35,000)
Technology Commercialization Project
PI: Bart Raeymaekers
Co-PI: Anthony Sanders
Title: Microtexturing knee implants to improve durability

EXTERNAL PROFESSIONAL SERVICE

- Peer review of research paper manuscripts for publication in Tribology Letters, Tribology Transactions, Journal of Tribology Trans. ASME, Tribology International, Wear, Scientific Reports, Composite Science and Technology, Microsystem Technologies, Journal of Engineering Tribology, Journal of Measurement Science and Technology, IEEE Trans. on Magnetics, IEEE Trans. on Ultrasound Ferroelectrics and Frequency Control, Ultrasonics, Journal of the Royal Society Interface, Materials and Design, Surfaces and Coatings, amongst other journals.
- National Science Foundation review panel, nanomanufacturing program, 01/18/2011, 06/01/2013
- 07/2015 – present: Executive Committee, Member, ASME Tribology division
- 07/2015 – present: Publication Committee, Chair, ASME Tribology division
- 10/2014 – present: Tribology Frontiers Conference Planning Committee, Member, Society of Tribologists and Lubrication Engineers (STLE)
- 06/2014 – present: ASME Information Storage and Processing Systems Conference, Conference Secretary
- 10/2013 – present: Early Career Committee, Member, Society of Tribologists and Lubrication Engineers (STLE)
- 10/2013 – present: Wear Committee, Member, Society of Tribologists and Lubrication Engineers (STLE)
- 10/2012 – present: Contact Mechanics Committee, Member, ASME Tribology division
- 07/2012 – present: Executive Committee, Member, ASME Information Storage and Processing Systems (ISPS) division

- 07/2012 – present: Organizing Committee, Member, ASME Information Storage and Processing Systems (ISPS) annual conference in Santa Clara, CA
- 06/2012 – present: Tribology Education Committee, Member, ASME Tribology division
- 07/2013: Co-organizer, Contact Mechanics Symposium at the Society of Engineering Science (SES) Conference in Providence, RI
- 10/2012: Session Organizer and Session Chair, Fluid film lubrication session, International Joint Tribology Conference in Denver, CO, USA. This includes accepting/rejecting papers submitted to the fluid film lubrication session after conducting external peer review
- 05/2012: Session Chair, Contact mechanics session at the 2012 Annual Meeting of the Society of Tribologists and Lubrication Engineers in St. Louis, MO, USA
- 11/2006: Session Chair, Contact mechanics session at the Austrib06 conference in Brisbane, Australia

INTERNAL SERVICE

Department service:
2016 – present: Faculty search committee (Design and manufacturing), Member
2015 – present: Capstone design committee, Member
2015 – present: Strategic planning committee, Member
2014 – present: Design, Ergonomics, Manufacturing, and Systems (DEMS) division, Chair
2014 – present: Machine shop committee, Chair
2014 – present: Executive committee, Member
2011 – present: Undergraduate curriculum committee, Member
2014 – 2015: Distinguished seminar committee, Member
2012 – 2014: Machine shop committee, Member
2015 – 2016: Faculty search committee (Design and manufacturing), Member
2014 – 2015: Faculty search committee (Design of mechanical/fluid systems), Member
2013 – 2014: Faculty search committee (Manufacturing), Member
2011 – 2012: Faculty search committee (Bio-design), Member

University service:
2015 – present: Digital manufacturing task force, Member

AFFILIATIONS

- American Society of Mechanical Engineers (ASME), member
- Society of Tribology and Lubrication Engineers (STLE), member

GRADUATE STUDENTS

Currently chair for

Name	M.S./Ph.D.	Graduating	Funding	Co-advisor
Alireza Borjali	Ph.D.	2018	50% RA/ 50% TA	N/A
John Greenhall	Ph.D.	2017	100% RA	N/A
Brooklyn Noble	Ph.D.	2019	100% RA	N/A
Michael Price	Ph.D.	2017	100% RA	N/A
Milo Prisbrey	Ph.D.	2021	100% RA	N/A
Margaret Goertzen	M.S.	Summer 2018	50% RA/ 50% TA	N/A
Heather Schaefer	M.S.	Fall 2017	N/A	N/A

Visiting students

Name	M.S./Ph.D.	Graduating	Home institution	Advisor
Blaz Zugelj	Ph.D.	2017	University of Ljublijana, Slovenia	Prof. Mitjan Kalin

Graduated students

<table>
<tr><th>Name</th><th>M.S./Ph.D.</th><th>Graduated</th><th>Thesis</th><th>Co-advisor</th></tr>
<tr><td rowspan="3">Leora Homel</td><td>M.S.</td><td>Spring 2017</td><td>Yes</td><td>N/A</td></tr>
<tr><td colspan="4">Thesis: Ultra-high weight fraction alignment of carbon nanotubes using ultrasound</td></tr>
<tr><td colspan="4">Job at graduation: Manufacturing Engineer, Tesla Motors, Fremont, CA</td></tr>
<tr><td rowspan="3">Carly Lockard</td><td>M.S.</td><td>Spring 2015</td><td>Yes</td><td>N/A</td></tr>
<tr><td colspan="4">Thesis: Quantifying fatigue crack damage in polyethylene tibial inserts of prosthetic knee joints</td></tr>
<tr><td colspan="4">Job at graduation: Research Engineer, Steadman Philippon Research Institute, Vail, CO</td></tr>
<tr><td rowspan="3">Michael Doran</td><td>M.S.</td><td>Fall 2014</td><td>Yes</td><td>Prof. J. Abbott</td></tr>
<tr><td colspan="4">Thesis: A superelastic helicotome for capsulorhexis</td></tr>
<tr><td colspan="4">Job at graduation: Product Engineer, Orbit Irrigation Products, North Salt Lake, UT</td></tr>
<tr><td rowspan="3">Matthew Cavilla</td><td>M.S.</td><td>Fall 2014</td><td>Yes</td><td>Prof. J. Abbott</td></tr>
<tr><td colspan="4">Thesis: A superelastic helicotome for capsulorhexis</td></tr>
<tr><td colspan="4">Job at graduation: Design Engineer, Merit Medical Systems, Salt Lake City, UT</td></tr>
<tr><td rowspan="3">Anthony Chyr</td><td>M.S.</td><td>Spring 2014</td><td>Yes</td><td>N/A</td></tr>
<tr><td colspan="4">Thesis: Experimental study of using a patterned microtexture to reduce friction in prosthetic hip joints</td></tr>
<tr><td colspan="4">Job at graduation: Analysis Engineer, Orbital ATK, Clearfield, UT</td></tr>
<tr><td rowspan="3">Michael R. Price</td><td>M.S.</td><td>Spring 2014</td><td>No</td><td>N/A</td></tr>
<tr><td colspan="4">Milestone M.S. degree en route to Ph.D. degree</td></tr>
<tr><td colspan="4">Currently Ph.D. student in Raeymaekers' lab</td></tr>
<tr><td rowspan="3">John J. Greenhall</td><td>M.S.</td><td>Fall 2013</td><td>No</td><td>N/A</td></tr>
<tr><td colspan="4">Milestone M.S. degree en route to Ph.D. degree</td></tr>
<tr><td colspan="4">Currently Ph.D. student in Raeymaekers' lab</td></tr>
<tr><td rowspan="3">Mingfeng Qiu</td><td>M.S.</td><td>Spring 2013</td><td>No</td><td>N/A</td></tr>
<tr><td colspan="4">Milestone M.S. degree en route to Ph.D. degree</td></tr>
<tr><td colspan="4">Currently Ph.D. student at the University of British Columbia, Canada</td></tr>
<tr><td rowspan="3">Michael Haslam</td><td>M.S.</td><td>Spring 2012</td><td>Yes</td><td>N/A</td></tr>
<tr><td colspan="4">Thesis: Aligning carbon nanotubes using ultrasound to reinforce composite materials</td></tr>
<tr><td colspan="4">Job at graduation: Design Engineer, DJH Engineering Center, Salt Lake City, UT</td></tr>
<tr><td rowspan="3">Gorakh Pawar</td><td>M.S.</td><td>Spring 2012</td><td>Yes</td><td>N/A</td></tr>
<tr><td colspan="4">Thesis: The effect of determining topography parameters on analyzing elastic contact between isotropic rough surfaces</td></tr>
<tr><td colspan="4">Currently Ph.D. student at the University of Utah, Dept. of Metallurgical Eng.</td></tr>
</table>

UNDERGRADUATE STUDENTS

Ongoing undergraduate research

N/A

Finished undergraduate research

Name	Level	Graduated	Funding	Co-advisor
Milo Prisbrey[§]	Senior	Spring 2016	UROP*	N/A
	Project: Creating 3D user-specified patterns of nanoparticles using ultrasound			
Jayden Plumb	Freshman	Spring 2018	Engineering Scholars Program	N/A
	Project: Nanoscale lubricant spreading demo			
Brooklyn Noble[§]	Senior	Spring 2014	UROP*	N/A
	Project: Molecular dynamics study of lubricant transfer between recording head and magnetic disk in hard drives			
Jacob Bryan	Freshman	Spring 2017	Engineering Scholars Program	N/A
	Project: Ultra-high loading rate nanocomposite materials			
Bret Minson[§]	Senior	Spring 2013	UROP*	R. Brannon
	Project: Effect of texture geometry on friction in parallel air bearings			
Anthony Chyr[§]	Senior	Spring 2013	UROP*	N/A
	Project: Design of an orthopedic implant testing apparatus			
Anthony Chyr[§]	Junior	Spring 2013	UROP*	N/A
	Project: Design of a micromanipulator to extract grains from sandstone			
Daniel Cowan	Senior	Spring 2012	Hourly	N/A
	Project: Design of an orthopedic implant testing apparatus			
Emir Hero	Senior	Spring 2012	Independent study	
	Project: Modeling of textured parallel air bearing surfaces			
Adis Delic[§]	Senior	Spring 2012	Independent study	
	Project: Modeling of textured parallel air bearing surfaces			

[§] Undergraduate student is co-author on at least one journal publication

*UROP: Undergraduate Research Opportunity (Funding provided through the University of Utah)

Capstone design projects advised

Project	Year	Funding	Co-advisor
Delayed feeding mechanism for bears	2016-2017	Hogle Zoo, SLC, UT	N/A
Submersible radioactive-resistant robot	2013-2014	Nuclear Engineering Dept., University of Utah	N/A
NASA Regolith Advanced Surface Systems Operations Robot (RASSOR)	2012-2013	NASA	Robert Mueller (NASA)

TEACHING EXPERIENCE

Term	Course number	Course title	Enrollment
Spring 2017	ME EN 3000	Design of mechanical elements	118
Fall 2016	ME EN 4010	Engineering Design II	40
Spring 2016	ME EN 3000	Design of mechanical elements	142
Fall 2015	ME EN 5960/6960	Nanotribology and contact mechanics	6
Spring 2015	ME EN 3000	Design of mechanical elements	153
Fall 2014	ME EN 3000	Design of mechanical elements	42
Spring 2014	ME EN 3000	Design of mechanical elements	165
Fall 2013	ME EN 5960/6960	Nanotribology and contact mechanics	10
Spring 2013	ME EN 3000	Design of mechanical elements	140
Fall 2012	ME EN 5620/6620	Fundamentals of microscale engineering	20
Spring 2012	ME EN 3000	Design of mechanical elements	130
Fall 2011	ME EN 5960/6960	Nanotribology and contact mechanics	9
Spring 2011	ME EN 3910	Design methodology	149

OUTREACH ACTIVITIES

10/2016: Engineering Scholars Lab Tour: Lab tours for freshmen in the "engineering scholars" program for high-achieving students.

10/2015: Engineering Scholars Lab Tour: Lab tours for freshmen in the "engineering scholars" program for high-achieving students.

06/2015: Hi-GEAR (Girls' Engineering Abilities Realized); my research group contributed a half-day tribology workshop to this program organized by the College of Engineering. 24 High school girls participated in a diverse set of hands-on tribology experiments.

10/2014: Engineering Scholars Lab Tour: Lab tours for freshmen in the "engineering scholars" program for high-achieving students.

06/2014: Hi-GEAR (Girls' Engineering Abilities Realized); my research group contributed a half-day tribology workshop to this program organized by the College of Engineering. 24 High school girls participated in a diverse set of hands-on tribology experiments.

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06/2013: Hi-GEAR (Girls' Engineering Abilities Realized); my research group contributed a half-day tribology workshop to this program organized by the College of Engineering. 24 High school girls participated in a diverse set of hands-on tribology experiments.

11/2012: Engineering Day Lab Tours: Lab tours for high school students and their parents visiting the University of Utah during engineering day.

10/2012: Engineering Scholars Lab Tour: Lab tours for freshmen in the "engineering scholars" program for high-achieving students.

OTHER ACTIVITIES

04/2015: Utah Bench to Bedside Competition: Participated as a judge for the final event of this medical innovation/business plan competition.

01/2014: Utah Opportunity Quest Entrepreneur Series: Participated as a judge for the final event of this business plan competition, evaluating ten early-stage start-up companies.

1996-2004: Semi-professional cyclist in Belgium.

ATTACHMENT B

FUJIFILM

FUJIFILM Corporation
MIDTOWN WEST, 7-3, AKASAKA 9-CHOME,
MINATO-KU, TOKYO 107-0052, JAPAN

COMMERCIAL INVOICE

DATE OF EXPORTATION	EXPORT REFERENCES
March 8, 2017	FedEx 7785 8673 5937
SHIPPER/EXPORTER **FROM:** Norihito Kasada Recording Media Products Div. FUJIFILM Corporation 2-12-1 Oogi-cho, Odawara-shi, Kanagawa 250-0001 Japan **PHONE:** 0465-32-6280	**SHIP TO** **TO:** Bart Raeymaekers, Associate Professor University of Utha Department of Mechanical Engineering 1495 East 100 South, 1550 MEK Salt Lake City, UT 84112 U.S.A **PHONE:** +1-801-585-7594
COUNTRY OF ORIGIN OF GOODS Japan **COUNTRY OF ULTIMATE DESTINATION** U.S.A.	**IMPORTER** Mr. Yuichi.Kurihashi FUJIFILM Recording Media U.S.A. Inc. 200 Summit Lake Drive, Valhalla, NY 10595-1356, U.S.A PHONE: 914-260-7289

F.O.B. JAPAN

NO. OF PKGS	DESCRIPTION OF GOODS	QTY	UNIT VALUE	TOTAL VALUE
1	**Sample of Magnetic Media** Magnetic Tape specimen HTS: 8523.29.1000 NO COMMERCIAL VALUE VALUE FOR CUSTOMS PURPOSE ONLY	6	US$ 5.00	US$30.00
			TOTAL	**USD 30.00**

I DECLARE THAT ALL INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT.

SIGNATURE OF SHIPPER/EXPORTER

Norihito Kasada

Recording Media Products Div.

DATE

March 8, 2017

FUJIFILM

FUJIFILM Corporation
MIDTOWN WEST, 7-3, AKASAKA 9-CHOME,
MINATO-KU, TOKYO 107-0052, JAPAN

COMMERCIAL INVOICE

DATE OF EXPORTATION	EXPORT REFERENCES
March 8, 2017	FedEx 7785 8673 5937
SHIPPER/EXPORTER **FROM:** Norihito Kasada Recording Media Products Div. FUJIFILM Corporation 2-12-1 Oogi-cho, Odawara-shi, Kanagawa 250-0001 Japan **PHONE:** 0465-32-6280	**SHIP TO** **TO:** Bart Raeymaekers, Associate Professor University of Utha Department of Mechanical Engineering 1495 East 100 South, 1550 MEK Salt Lake City, UT 84112 U.S.A **PHONE:** +1-801-585-7594
COUNTRY OF ORIGIN OF GOODS Japan **COUNTRY OF ULTIMATE DESTINATION** U.S.A.	**IMPORTER** Mr. Yuichi.Kurihashi FUJIFILM Recording Media U.S.A. Inc. 200 Summit Lake Drive, Valhalla, NY 10595-1356, U.S.A PHONE: 914-260-7289

F.O.B. JAPAN

NO. OF PKGS	DESCRIPTION OF GOODS	QTY	UNIT VALUE	TOTAL VALUE
	Sample of Magnetic Media			
1	Magnetic Tape specimen	6	US$ 5.00	US$30.00
	HTS: 8523.29.1000 NO COMMERCIAL VALUE VALUE FOR CUSTOMS PURPOSE ONLY		**TOTAL**	**USD 30.00**

I DECLARE THAT ALL INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT.

SIGNATURE OF SHIPPER/EXPORTER

Norihito Kasada
Recording Media Products Div.

DATE
March 8, 2017

ATTACHMENT C

ORIGIN ID:HTRA 0465326280
NORIHITO KASADA
FUJIFILM CORPORATION
RECORDING MEDIA PRODUCTS DIV.
2-12-1,OOGI-CHO, ODAWARA-SHI,
KANAGAWA, 2500001
JAPAN JP

SHIP DATE: 08MAR17
ACTWGT: 5.00 KG
CAD: 101232959/NET3851

BILL SENDER

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84112
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1. 水平ラインに沿ってページを折ります
2. ラベルをパウチに入れて貨物に貼付します

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Ship Date: 06MAR17
ActWgt: 5.00 KG
CAD: 101232959/NET3851

BILL SENDER
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AWB

J171117021420uv

WL NPHA

PKG TYPE: CUSTOMER

TRK# 7785 8673 5937 Form 0430

INTL PRIORITY

REF:
DESC1:Magnetic tape analysis sample
DESC2:
DESC3:
DESC4:

COUNTRY MFG: JP
CARRIAGE VALUE: 0.00 USD
CUSTOMS VALUE: 30.00 USD

SIGN: Norihito Kasada
T/C: S 187397324
D/T: S 187397324

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