

## JACQUELINE KRIM

Distinguished University Professor Emerita of Physics  
Department of Physics, North Carolina State University, Raleigh, NC 27695-8202  
(919) 513-2684, jkrim@ncsu.edu, www.physics.ncsu.edu/nanotribology

### EDUCATION

1978 B.A., Physics	University of Montana, Missoula, MT
1984 Ph.D. Physics	University of Washington, Seattle, WA
1976	American Institute of Foreign Study (U.S.S.R.)(summer)
1977	University of California, Berkeley, CA (summer)

### POSITIONS HELD

#### North Carolina State University, Raleigh, NC

1998 - present: Professor (1998), Distinguished University Professor (2014), Distinguished University Professor Emerita (2020) of Physics

2011 - 2015 Associate Dean for Research, College of Sciences\*

#### Northeastern University, Boston, MA

1985-1998: Assistant (1985), Associate (1992), Full (1996) Professor of Physics

#### Sabbatical, post-doctoral and graduate appointments

1991-1992: Senior Research Fellow, Katholieke University Leuven, Belgium

2009 (calendar year) Visiting Professor of Physics, Duke University, Durham, NC

1984-1985: NATO Postdoctoral Fellow, Universite d'Aix-Marseille, France

1980-1984: Research Associate, University of Washington, Seattle, WA

**HONORS: 2019 Fellow, American Association for the Advancement of Science (AAAS),** *For distinguished contributions to the understanding of atomic-scale friction, wetting and surface roughening, and for exemplary efforts in scientific outreach and diversity;* **2018 Fellow, Society of Tribologists & Lubrication Engineers (STLE); 2015 American Physical Society (APS) David Adler Lectureship Award,** *For pioneering work in the physics of tribology and for excellent outreach to scientific and nonscientific audiences;* **2014 APS Outstanding Referee; 2010 NSF American Competitiveness and Innovation Fellow; 2002 NCSU Alumni Outstanding Research Award; 2001 Sigma Xi Distinguished Lecturer; 2000 Fellow, APS,** *For pioneering contributions to surface science and nanotribology, especially studies of kinetic roughening and the development of quartz crystal microbalance as a major tool for probing atomic-scale friction;* **1999 Fellow, American Vacuum Society,** *For elucidating fundamental aspects of friction, wetting, and roughening at surfaces;* **1995 NSF DMR Creativity Award, 1994 R.F. Bunshah Best Paper Award,** *Int. Conf. on Metallurgical Coatings and Thin Films,* **1987 NSF Presidential Young Investigator Award; 1984 NATO Postdoctoral Fellow, 1984 First annual Joseph and Evelyn Henderson Award, *for excellence in completed graduate research at the U. of Washington;* **1983 Achievement Reward for College Scientists, (ARCS) dissertation fellowship for outstanding doctoral students; 1975-1978 Tuition waiver from the U. of Montana, for academic excellence; 1978 B.A. with High Honors; 1974 Higher education scholarship, as winner of the statewide design competition for the Bicentennial Commemorative Medallion for the State of Wisconsin.****

\* College of Physical and Mathematical Sciences prior to 2012 reorganization to include bioscience.

## **PROFESSIONAL ACTIVITIES**

### **American Physical Society, Member since 1983**

- Organizer, Focused Session on Tribology, March 1996, 1998, 2002, 2011 Meetings
- Organizer, Focused session on Van der waals interactions, March 2012, 2013 Meetings
- Member-at-Large to the Executive Committee of the Division of Materials Physics for the American Physical Society, (02-05) and Division of Condensed Matter Physics (05-08)
- Vice-chair, (Chair) of the Davidson Germer prize committee for the 2009 (2011) prize.
- DCMP fellowship award committee for 2007-2009
- Vice chair and chair for APS Southeast section, Beams award for research, 2008-2009
- Outreach to Congress advisory committee. 2008-2009
- David Adler lectureship award committee, 2016-2018
- Physical Review Applied Editorial Board, 2016- present
- Committee on Scientific Meetings, 2020-present

### **American Vacuum Society, Member since 1987**

- Nanometer Science & Technology Division: Executive Committee (1992-94); (2011-13)
- Student Issues Committee (1989-1999); Co-Chair (1989-1991)
- Board of Trustees (1992-1995); Chair (1994-1995)
- Surf. Sci. Division: Exec. Committee (95-99); Program Chair (1998); Division Chair (1999)
- Organizer, Session on Atomic-Scale Friction, ICMCTF, April 1995
- Organizer, Session on Atomic-Scale Friction, ICMCTF, April 1996
- Chair of the AVS Education Committee, charged with coordination of scientific and technical outreach efforts at the national level for the AVS.
- AVS representative to the AIP Liaison Committee on Physics Education. 2004, 2005

### **Society of Tribologists and Lubrication Engineers, Member since 1996**

- Editorial Board Member for Tribology Transactions (1996 - 2003)
- Editorial Board Member for Tribology Letters (1996 - present)
- Nanotribology short course instructor (2012, 2019 STLE National Symposium)
- ARPA-E Tribology Opportunities Study (contributing author)

### **Sigma Xi, The Scientific Research Society, Member since 2001**

- Distinguished lecturer, 2001-2003
- Distinguished lecturer selection committee, 2014-2016

### **Southeast Conference for Undergraduate Women in Physics 2009-2011**

- Organizing committee and National Organizing Committee (2009-2014)
- Local Organizing committee, 2010 conference

### **American Association for the Advancement of Science, Member since 2013**

## **Editorial Boards, Journals and Publications**

- Editorial Board Member for Tribology Letters, 1996 - present
- Advisory Editorial Board for Surface Science, 1999 - 2004
- Editorial Board Member for Tribology Transactions, 1997 - 2003
- Editorial Board Member for Physical Review Applied, 2016 – present
- Editorial Board Member for Frontiers in Mechanical Engineering: Tribology, 2019-present
- Guest Editor, Applied Surface Science Advances, 2020-2021

## **GRADUATE, UNDERGRADUATE AND POSTDOCTORAL MENTORSHIP ACTIVITIES**

### **Graduate Students: (24 Ph.D's supervised, 2 M.S.; 2 in progress)**

Eric Watts (Boeing, El Segundo, CA), Ronald Chiarello (C.E.O., Jetalon Solutions), Vania Panella (Author, Perugia, Italy), George Palasantzas (Univ. Of Groningen, The Netherlands), Christopher Daly (Hewlett Packard, Boston, MA), Chihong Mak (Linear Manufacturing, Hong Kong), Angela J. Dayo (Freelance writer), Silvina Tomassone, (Rutgers University), Mohamed Abdelmaksoud (Cairo University), Steve Winder (employment status unknown); Tonya Coffey (Appalachian State University, Boone, NC), Chernoye (Brookhaven National Lab.), Matthew Highland (Argonne National Lab.), Worakarn Neeyakorn (King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand), Manju Varma (Qualcomm Corp.) Matthew Walker (Northrop Grumman, Baltimore, MD), Brendan Miller (Chevron Corp., San Francisco, CA), Chris Brown (Sail Venture Partners), Benjamin Dawson (Western Digital, Irvine, CA), Liming Pan (Northern Trust Company, Chicago, IL), D.Adam Hook (Environmental Protection Agency, Research Triangle Park, NC)), Iyam Lynch (Corinthian Ophthalmic, Boone, NC), Diana Berman (University of North Texas), Zijian Liu (Xin Clean Energy, Vertical Carbon Technologies, Newport News, VA), Keeley Stevens (Ph. D. in progress), Zachary Fredricks (906 Improvements LLC, Raleigh, NC), Samuel Kenny (Ph.D. in progress), Colin Curtis (M.S) Biplav Acharya (Intel Corp., Oregon), Caitlin Seed (Ph.D. in progress)

### **Postdoctoral Research Associates:**

Klaus Mecke, (Univ. of Wuppertal), Brian Borovsky, (St. Olaf College), Kurt Ketola (Ratheon Corp), Sang Min Lee (Semiconductor firm California Bay), Mohamed Abdelmaksoud (Cairo University), Jonathan Bender (Afton Corporation), Brian Mason (Stanford Research Systems ), Richard Chromik (McGill University, Montreal), Colin Baker (Naval Research Laboratory), Igor Altfeder (Wright Patterson Air Force Research Laboratory, Dayton, OH), Nimel Theodore (Naval Research Laboratory)

### **Undergraduate Research Participants and high school interns:**

Frederick Kustin, Robert D. Kaiser, W. Alnasrallah, Michael Rose, Hymen Carrel, Eric Lada, Christine Lin, Lucas Wagner, Marcia Archibald, Alex Mayer, Kevin Rasch, Megan Miller, Daryl Purcell, Christina Hammock, Chole Palanchar, Danny Wise, Troy Bradshaw, Joe L. Browning, Allyson Hutchinson, Omar Parker, Jennifer Patton, Alex Mayer, Daryl Purcell, Chris Shumaker; Andrew Larson, Andrew Brown, Brian Vlastakis, Kyle Barefoot,

Jessica McNutt, Jonathan Pike, Edward Stevens, Ben Keller, Steve Corely, Rebecca Rosenfeld, Dustin Leninger, Brian McCann, Laura Goodman, Andrew Wright, Keshav Avva, Tyler Pardue, Binita Thapa, Rachel Andrus, Justin Shu, Brigid Donohue, Jenni Mangala

## SCIENTIFIC PUBLICATION LIST

**PUBLICATIONS: 163 Citations: 8300+ H factor: 45+**

1. “*Complete and Incomplete Wetting of Krypton and Oxygen on Graphite: Reentrant Type 2 Growth on a Scale of Substrate Strength*”, M. Bienfait, J.L. Seguin, J. Suzanne, E. Lerner, J. Krim and J.G. Dash, *Physical Review B* **29**, 983-987, (1984)
2. “*Wetting Behavior of Simple Molecular Gases Physically Adsorbed On Au(111)*”, J. Krim, thesis, University of Washington, 199, (1984)
3. “*Wetting and Nonwetting of Molecular Films at Zero Temperature*”, R.J. Muirhead, J.G. Dash and J. Krim, *Physical Review B* **29**, 5074-5080, (1984)
4. “*Triple Point Wetting of Light Molecular Gases on Au(111) Surfaces*”, J. Krim, J.G. Dash and J. Suzanne, *Physical Review Letters* **52**, 640-643, (1984)
5. “*On the Limit of Compression of a Physisorbed Monolayer*”, L.W. Bruch, J.M. Gay and J. Krim, *Journal de Physique Journal de Physique* **46**, 425-433, (1984)
6. “*Incomplete Wetting of <sup>4</sup>He Films on Ag and Au(111) Surfaces*”, A.D. Migone, J. Krim, J.G. Dash and J. Suzanne, *Physical Review B* **31**, 7643-7650, (1985)
7. “*Incomplete Wetting of Helium Films*”, J. Krim and J.G. Dash, *Surface Science* **162**, 421-425, (1985)
8. “*A LEED and Neutron Diffraction Study of Submonolayer Hexane Adsorbed on Graphite in the Monolayer Range: Uniaxial Commensurate-Incommensurate Transition*”, J. Krim, J. Suzanne, H. Shechter, R. Wang and H. Taub, *Surface Science* **162**, 446-451, (1985)
9. “*Fiber Texture and Surface Composition of Evaporated Gold Films On Quartz*”, J. Krim, *Thin Solid Films* **137**, 297-303, (1986)
10. “*Q-Factors of Quartz Oscillator Modes as a Probe of Submonolayer Film Dynamics*”, A. Widom and J. Krim, *Physical Review B (Rapid Communications) Physical Review (Rapid Communications)B* **34**, R3-6, (1986)
11. “*A LEED Study of Methane Films Adsorbed on Graphite in the Monolayer Range*”, J.M. Gay, A. Dutheil, J. Krim and J. Suzanne, *Surface Science* **177**, 25-35, (1986)

12. “*Incomplete Wetting of Methane on Graphite at Low Temperature*”, J. Krim, J.M. Gay, J. Suzanne and E. Lerner, *Journal de Physique (Paris)* **47**, 1757-1762, (1986)
13. “*Influence of Film Melting Characteristics on the Wetting Behavior of Multilayer Oxygen Films Adsorbed on Graphite*”, J. Krim, J.P. Coulomb and J. Bouzidi, *Journal of Vacuum Science and Technology A* **5**, 1096-1099, (1987)
14. “*Triple Point Wetting and Surface Melting of Oxygen Films Adsorbed on Graphite*”, J. Krim, J.P. Coulomb and B. Bouzidi, *Physical Review Letters* **58**, 583-586, (1987)
15. “*Neutron Scattering Study of Methane Bilayer and Trilayer Films on Graphite*”, J.Z. Larese, M. Harada, L. Passell, J. Krim and S. Satija, *Physical Review B* **37**, 4735-4742, (1988)
16. “*Surface Melting of Multilayer Oxygen Films on Graphite Studied by Neutron Diffraction*”, R. Chiarello, J.P. Coulomb, J. Krim and C.L. Wang, *Physical Review B* **38**, 8967-8973, (1988)
17. “*Damping of a Crystal Oscillator by an Adsorbed Monolayer and its Relation to Interfacial Viscosity*”, J. Krim and A. Widom, *Physical Review B* **38**, 12184-12189, (1988)
18. “*Roughness and Porosity Characterization of Carbon and Magnetic Films through Adsorption Isotherm Measurements*”, C.L. Wang, J. Krim and M.F. Toney, *Journal of Vacuum Science and Technology A* **7**, 2481-2485, (1989)
19. “*Multilayer Adsorption on a Fractally Rough Surface*”, P. Pfeifer, Y.J. Wu, M.W. Cole and J. Krim, *Physical Review Letters* **62**, 1997-2000, (1989)
20. “*Influence of Surface Melting Characteristics on the Wetting Behavior of Solid Adsorbed Films*”, R. Chiarello and J. Krim, *Langmuir* **5**, 567-570, (1989)
21. “*Measurement of Protein Hydration Shells Using a Quartz Microbalance*”, L. Reinisch, R.D. Kaiser and J. Krim, *Physical Review Letters* **63**, 1743-1746, (1989)
22. “*Wetting of Fractally Rough Surfaces*”, P. Pfeifer, M.W. Cole and J. Krim, *Physical Review Letters* **65**, 663, (1990)
23. “*Slippage of Simple Liquid Films adsorbed on Silver and Gold Substrates*”, J. Krim, E.T. Watts and J. Digel, *Journal of Vacuum Science and Technology A* **8** (4), 3417-3420, (1990)
24. “*Experimental Observation of Interfacial Slippage at the Boundary of Molecularly Thin Films with Gold Substrates*”, E.T. Watts, J. Krim and A. Widom, *Physical Review B* **41**, 3466-3472, (1990)
25. “*Multilayer Adsorption on a Fractally Rough Surface*”, P. Pfeifer et al., *Dynamics of Fractal Surfaces*, F. Family and T. Vicsek, eds. (World Scientific, Singapore, 435, 1991) reprinted from *Physical Review Letters* **62**, 1997-2000, (1989)

26. "Probing Films Phase Transitions through Measurements of Sliding Friction", J. Krim, in *Phase Transitions in Surface Films 2*, H. Taub, ed. (B267, NATO ASI Series, Plenum, New York, 169-182, 1991) **invited**
27. "X-Ray Reflectivity and Adsorption Isotherm Study of Fractal Scaling in Vapor-Deposited Films", R. Chiarello, V. Panella, J. Krim and C. Thompson, *Physical Review Letters* **67**, 3408-3411, (1991)
28. "Sliding Friction Measurements of Molecularly Thin Films", J. Krim and R. Chiarello, *Journal of Vacuum Science and Technology A*, **9**, 2566-2569, (1991)
29. "Sliding Friction Measurements of Physisorbed Monolayers: A Comparison of Solid and Liquid Films", J. Krim and R. Chiarello, *Journal of Vacuum Science and Technology B*, **9**, 1343-1346, (1991)
30. "Nanotribology of a Kr Monolayer: A Quartz Crystal Microbalance Study of Atomic-Scale Friction", J. Krim, D. Solina and R. Chiarello, *Physical Review Letters* **66**, 181-184, (1991)
31. "Characterization of the Surface Fractal Dimension of Evaporated Silver and Gold Films through Adsorption Isotherm Measurements", J. Krim and V. Panella, *Studies in Surface Science and Catalysis: Characterization of Porous Solids II*, Rodriguez-Reinoso, Rouquerol, Sing and Unger, eds., pp. 217-224 (Elsevier, Amsterdam, 1991)
32. "Roughness and Porosity Characterization of Solid Films through Adsorption Isotherms Recorded with a Quartz Crystal Microbalance", J. Krim and E.T. Watts, *Fundamentals of Adsorption*, A.B. Mersmann and S.E. Scholl, Eds., pp. 445-454 (Engineering Foundation, New York, 1991)
33. "Self-Affine Scaling in Vapor-Deposited Metal Films", J. Krim, in *Surface Disordering: Growth, Roughening and Phase Transitions*, R. Jullien, J. Kertesz, P. Meakin and D.E. Wolf (Nova Science, Commack 77-83, 1992), **invited**
34. "Adsorbate Surface Tension Effects for Isotherms Recorded on Fractally Rough Surfaces", V. Panella and J. Krim, *Studies in Surface Science and Catalysis: Characterization of Porous Solids III*, Rouquerol, Sing and Unger, eds., (Elsevier, Amsterdam, 1993)
35. "Determination of an Atomic-Scale Frictional Force Law through Quartz Crystal Microbalance Measurements", J. B. Sokoloff, J. Krim and A. Widom, *Physical Review B* **48**, 9134-9137, (1993)
36. "Roughness Exponents: a Paradox Resolved", J. Krim and J.O. Indekeu, *Physical Review E* **48**, 1576-1578, (1993)

37. "Effect of the Form of the Height-Height Correlation Function on Diffuse X-ray Scattering from a Self-Affine Surface" G.Palasantzas and J.Krim, Physical Review B **48**, 2873-2877, (1993)
38. "Scanning Tunneling Microscopy Observation of Self-Affine Fractal Roughness in Ion-Bombarded Film Surfaces", J. Krim, I. Heyvaert, C. Van Haesendonck and Y. Brunseraede, Physical Review Letters **70**, 57-61, (1993)
39. "Adsorption Isotherm Study of the Static and Dynamic Scaling Behavior of Vapor-Deposited Silver Films", V. Panella and J. Krim, Physical Review E **49**, 4179-4184, (1994)
40. "Probing Surface Roughness and Porosity through Adsorption of Wetting Layers", J. Krim and V. Panella, Proc. Fall 1994 MRS Meeting, Symposium N
41. "Scanning Tunneling Microscopy Study of Kinetic Roughening in the Thick-Film Limit", G. Palasantzas and J. Krim, Physical Review Letters **73**, 3564-3567, (1994)
42. "Combined Scanning Tunneling Microscope and Quartz Microbalance Study of Molecularly Thin Water Layers", J. Krim, A. Dayo and C. Daly, in *Atomic Force Microscopy/Scanning Tunneling Microscopy*, S.H. Cohen *et al.*, eds. (Plenum Press, New York, 211-215, 1994)
43. "Applications of a Combined Scanning Tunneling Microscopy and Quartz Microbalance", C. Daly and J. Krim, in *Atomic Force Microscopy/Scanning Tunneling Microscopy*, S.H. Cohen *et al.*, eds. Plenum Press, New York, 303-309, (1994)
44. "Atomic-Scale Friction Measurements on Silver and Chemisorbed Oxygen Surfaces" C. Mak, C. Daly and J. Krim, Thin Solid Films **253**, 190-193, (1994)
45. "X-Ray Reflectivity Study of the Growth Kinetics of Vapor-Deposited Silver Films", C. Thompson, G. Palasantzas, Y.P. Feng, S.K. Sinha and J. Krim, **49**, 4902-4907, (1994)
46. "Wetting Behavior of Water and Xenon Adsorbed on Gold and Quartz", R.P. Chiarello, J. Krim, and C. Thompson, Surface Science **306**, 359-366, (1994)
47. "Spreading Diffusion and its Relation to Sliding Friction in Molecularly Thin Adsorbed Films", A. Widom and J. Krim, **49**, 4154-4156, (1994)
48. "Adsorbate Surface-Tension Effects for Isotherms Recorded on Fractally Rough Surfaces", V. Panella and J. Krim, Stud. Surf. Sci. Catal. **87**, 91-98, (1994)
49. "Electronic Contributions to Sliding Friction", J. Krim, C. Daly and A. Dayo, Tribology Letters, **1**, 211, (1995)
50. "Quartz Monitors and Microbalances", J. Krim and C. Daly, in Handbook of Thin Film Process Technology, D. Glocker and I. Shah, Eds. (IOP Publishing, Philadelphia, D4.0:1-6, 1995). **invited**

51. “*Progress in Nanotribology: Experimental Probes of Atomic Scale Friction*”, J. Krim, Comments in Condensed Matter Physics **17**, 263-280, (1995)
52. “*Nanotribology: The Atomic-Scale Origins of Friction*”, J. Krim, in Physics News in 1995, P.F. Schewe and B.P. Stein, Eds. (AIP, College Park, 67-68, 1995) **invited**
53. “*Experimental Observations of Self-Affine Scaling and Kinetic Roughening at Sub-Micron Lengthscales*”, J. Krim and G. Palasantzas, International Journal of Modern Physics B **9**, 599-632, (1995), **invited**
54. “*Friction and Damping of Xe/Ag(111)*”, C. Daly and J. Krim, Surface Science, **368**, 49, (1996)
55. “*Fractal Scaling Behavior of Water Flow Patterns on Inhomogeneous Surfaces*”, M.S. Tomassone and J. Krim, Phys. Rev. E, **54**, 6511, (1996)
56. “*Surface Morphology and Kinetic Roughening of Ag on Ag(111) Studied with Scanning Tunneling Microscopy*”, I. Heyvaert, J. Krim, C. Van Haesendonck and Y. Bruyseraede, Phys. Rev. E, **54**, 349, (1996)
57. “*Electronic Contributions to Sliding Friction*”, J. Krim and C. Daly, Physics of Sliding Friction, B.N.J. Persson and E. Tosatti, eds. (Kluwer, Dordrecht, 191, 1996), **invited**
58. “*Friction at the Atomic Scale*”, J. Krim, Scientific American, cover story for the October 1996 issue, **275**, 74-80, (1996), **invited**
59. “*Adequacy of the Lifshitz Theory for Certain Thin Adsorbed Films*”, V. Panella, R. Chiarello and J. Krim, Phys. Rev. Lett. **76**, 3606, (1996)
60. “*The Atomic-scale Origins of Friction*”, J. Krim, Langmuir, **12**, 4564, (1996)
61. “*Sliding Friction of Xenon Monolayers and Bilayers on Ag(111)*”, C. Daly and J. Krim, Phys. Rev. Lett. **76**, 803-806, (1996)
62. “*Adsorption Isotherms and Thermal Fluctuations*”, K.R. Mecke and J. Krim, Phys. Rev. B **53**, 2073-2082, (1996)
63. “*Electrical Resistivity and Quartz Crystal Microbalance Studies of Sliding Friction in Xe/Ag(111)*”, A. Dayo and J. Krim, in Friction, Arching and Contact Dynamics, D.E. Wolf and P. Grassberger eds. (World Scientific, Singapore, 47, 1997) **invited**
64. “*Quartz Crystal Microbalance Studies of Disorder-Induced Lubrication*”, C. Mak and J. Krim, Faraday Discussions, **107**, 389, (1997)



65. "Measurement and Modeling of Surface Micromachined, Electrostatically Actuated Microswitches", S. Majumder, N.E. McGruer, P. Zavracky, G.G. Adams, R.H. Morrison and J. Krim, *Transducers* (1997)
66. "Friction at the Atomic Scale", J. Krim, *Lubrication Engineering*, cover story for the January 1997 issue, **53**, 8-13 (1997), reprinted from *Scientific American*, **275**, 74-80 (1996)
67. "Sliding Friction of Compressing Xe Monolayers", C. Daly and J. Krim, in *Micro/Nanotribology and its Applications* B. Bhushan, ed.(Kluwer, Dordrecht, 311, 1997)
68. "Molecular Dynamics simulations of Sliding Friction in Xe/Ag(111)", S. Tommassone, J.B. Sokoloff, A. Widom and J. Krim, *Phys. Rev. Lett.*, **79**, 4798, (1997)
69. "Atomic-Scale Friction in Xe/Ag and N2/Pb", A. Dayo and J. Krim, *Int. Jour. Thermophys.* **19**, 827-834, (1998)
70. "Quartz Crystal Microbalance Studies of the Velocity Dependence of Interfacial Friction", C. Mak and J. Krim, *Phys. Rev. B* **58**, 5157-5159, (1998)
71. "Energy Dissipation in Interfacial Friction", M.O. Robbins and J. Krim, *MRS Bulletin*, **23**, 23-26 (1998), **invited**
72. "Fundamentals of Friction", J. Krim, guest editor, *MRS Bulletin*, cover story for the June 1998 issue, **23**, 20-21, (1998), **invited**
73. "Nanotribology of Vapor-Phase Lubricants", J. Krim and M. Abdelmaksoud, in *Tribology Issues and Opportunities in MEMS*, B. Bhushan, ed.(Kluwer Academic, Dordrecht, 273-284, 1998) **invited**
74. "Superconductivity-Dependent Sliding Friction", A. Dayo, W. Alnasrallah and J. Krim, *Phys. Rev. Lett.* **80**, 1690, (1998)
75. "Tuning Friction with Noise and Disorder", Y. Braiman, F. Family, H.G.E. Hantschel, C. Mak and J. Krim, *Phys. Rev. E (Rapid Communications)* **59**, R4737-R4740, (1999)
76. "Quartz Crystal Microbalance Studies of Superconductivity-dependent Sliding Friction", J. Krim, *Phys. Rev. Lett.* **6**, 1262, (1999)
77. "Friction", F.Family and J. Krim, *McGraw-Hill Yearbook of Science and Technology 2000*, 183 **invited** (Mcgraw-Hill, New York, 1999)
78. "Against all Odds: The Triumphs and Defeats of Lise Meitner", J. Krim, *The Physics Teacher*, **37**, 202, (1999) **invited**
79. "Friction at the atomic scale", J. Krim, *Abstracts Of Papers Of The American Chemical Society* **219**: U510-U510 54-COLL Part 1, (2000)

80. "Scanning Tunneling Microscope Measurements of the Amplitude of Vibration of a Quartz Crystal Oscillator", B. Borovsky, B.L. Mason and J. Krim, J. Appl. Phys. **88**, 4017, (2000)
81. "On the current status of quartz crystal microbalance studies of superconductivity-dependent sliding friction", B.L. Mason, S. M. Winder, J. Krim, Tribology Letters **10** (1-2): 59-65, (2001)
82. "A scanning probe and quartz crystal microbalance study of the impact of C-60 on friction at solid-liquid interfaces", T. Coffey, M. Abdelmaksoud, J. Krim, Journal Of Physics-Condensed Matter **13** (21): 4991-4999, (2001)
83. "Lubrication mechanisms of tricresylphosphate, TCP, on Cr and Fe surfaces at elevated temperatures: An atomic-scale view", M. Abdelmaksoud, B. Borovsky, J. Krim, Abstracts Of Papers Of The American Chemical Society **221**: U348-U349 267-COLL Part 1, (2001)
84. "Study of contacts in an electrostatically actuated microswitch", S. Majumder, N.E. McGruer, G.G. Adams, P. M. Zavracky, R. H. Morrison, J. Krim, Sensors And Actuators A-Physical **93** (1): 19-26, (2001)
85. "Measuring nanomechanical properties of a dynamic contact using an indenter probe and quartz crystal microbalance", B. Borovsky, J. Krim, Asif S. A. Syed, K. J. Wahl, Journal Of Applied Physics **90** (12): 6391-6396, (2001)
86. "Surface science and the atomic-scale origins of friction: what once was old is new again", J. Krim, Surface Science **500** (1-3): 741-758, (2002)
87. "QCM studies of the slippage of adsorbed monolayers in open and confined geometries", J. Krim, Abstracts Of Papers Of The American Chemical Society **223**: C92-C92 493-PHYS Part 2, (2002)
88. "Resource Letter: FMMLS-1: Friction at macroscopic and microscopic length scales", J. Krim, American Journal Of Physics **70** (9): 890-897, (2002)
89. "Nanotribology of a vapor-phase lubricant: A quartz crystal microbalance study of tricresylphosphate (TCP) uptake on iron and chromium", M. Abdelmaksoud, J. W. Bender, J. Krim, Tribology Letters **13** (3): 179-186, (2002)
90. "QCM-STM studies of the nanoscale dynamics of "model system" and "real-world" lubricants", M. Abdelmaksoud, J. Bender, J. Krim, Abstracts Of Papers Of The American Chemical Society **225**: U617-U617 65-COLL Part 1, (2003)
91. "Bridging the gap between macro- and nanotribology: A quartz crystal microbalance study of tricresylphosphate uptake on metal and oxide surfaces", M. Abdelmaksoud, J. W. Bender, and J. Krim, Physical Review Letters **92**, (17): Art. # 176101, (2004)

92. "Applications of the Piezoelectric Quartz Crystal Microbalance for Microdevice Development", J.W. Bender and J. Krim, in *Microdiagnostics*, K. Breuer ed. (Springer Verlag, New York, 2004)
93. "Scanning Tunneling microscope-quartz crystal microbalance studies of "Real world" and model lubricants", J. Krim, M. Abdelmaksoud, B. Borovsky, and S. M. Winder, *Dynamics And Friction In Submicrometer Confining Systems ACS Symposium Series* **882**: (2004)
94. "Foundations of Nanomechanics: From Solid-State Theory to Device Applications", Book Review by J. Krim, *Physics Today* (May 2004) pp. 58-59.
95. "Friction at the nanoscale", J. Krim, *Physics World* **18**, (2): 31-34, (2005)
96. "OTS adsorption: A dynamic QCM study", Y. Hussain, J. Krim, and C. Grant, *Colloids And Surfaces A-Physicochemical And Engineering Aspects* **262**, (1-3): 81-86, (2005)
97. "Impact of substrate corrugation on the sliding friction levels of adsorbed films", T. Coffey, and J. Krim, *Physical Review Letters* **95**, (7): Art.#. 076101, (2005)
98. "Scanning tunneling microscopy characterization of the surface morphology of copper films grown on mica and quartz", S.M. Lee, and J. Krim, *Thin Solid Films* **489**, (1-2): 325-329, (2005)
99. "Quartz-crystal microbalance studies of the slippage of solid and liquid krypton monolayers on metal(111) and C-60 surfaces", T. Coffey, and J. Krim, *Physical Review B* **72**, (23): Art. #. 235414, (2005)
100. "C-60 molecular bearings and the phenomenon of nanomapping", T. Coffey, and J. Krim, *Physical Review Letters* **96**, (18): Art. #. 186104, (2006)
101. "Superconductivity dependent friction of water, nitrogen, and superheated he films adsorbed on Pb(111)", M. Highland, and J. Krim, *Physical Review Letters* **96**, (22): Art. # 226107, (2006)
102. "STM, QCM, and the windshield wiper effect: A joint theoretical-experimental study of adsorbate mobility and lubrication at high sliding rates", M. Abdelmaksoud, S. M. Lee, C.W. Padgett, D. W. Irving, D. W. Brenner, and J. Krim, *Langmuir* **22**, (23): 9606-9609, (2006)
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104. "Multiscale analysis of liquid lubrication trends from industrial machines to micro-electrical-mechanical systems", D.W. Brenner, D.L. Irving, A.I. Kingon, and J. Krim, *Langmuir* **23**, (18): 9253-9257, (2007)

105. “*Dynamics of vapor-phase organophosphates on silicon and OTS*”, W. Neeyakorn, Worakarn), M. Varma, C. Jaye, J.E. Burnette, S.M. Lee, R.J. Nemanich, Robert, C.S. Grant, and J. Krim, *Tribology Letters* **27** (3): 269-276, (2007)
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107. “*QCM tribology studies of thin adsorbed films*”, J. Krim, *Nano Today* **2** (5): 38-43, (2007)
108. “*Gas adsorption on a C-60 monolayer*”, R.A. Trasca, M.W. Cole, T. Coffey and J. Krim, *Phys. Rev. E* **77**, art # 041603, (2008)
109. “*The Role of Creep in the Time-Dependent Resistance of Ohmic Gold Contacts in Radio Frequency Micro-Electromechanical System Devices*”, O. Rezvanian , C. Brown , M.A. Zikry , A.I. Kingon , J. Krim, D.L. Irving and D.W. Brenner, *J. Appl. Phys.* **104**, 024513 (2008)
110. “*Tribological Degradation of Fluorocarbon Coated Silicon Microdevice Surfaces in Normal and Sliding Contact*”, D. A. Hook, S. J. Timpe, M. T. Dugger and J. Krim, *J. Appl. Phys.* **104**, art # 034303 (2008)
111. “*Cryogenic Performance of RF MEMS Switch Contacts*”, C. Brown, O. Rezvanian, M. Zikry and J. Krim, *J. Microelectromechanical Systems*, **17**, 1460-1467 (2008)
112. “*Comparison of Au and Au-Ni alloys as contact materials for MEMS switches*”, Z Yang, DJ Lichtenwalner, A Morris, J Krim and AI Kingon, *J. of Microelectromechanical Systems*, **18**, 287 – 295 (2009)
113. “*Temperature dependence of asperity contact and contact resistance in gold RF MEMS switches*”, C. Brown, O. Rezvanian, M.A. Zikry, and J. Krim, *J. Microelectromechanical Systems*, **19**, art.# 025006 (2009)
114. “*Magic-sized Diamond Nanocrystals*”, I. Altfeder, J. Hu, A. Voevodin and J. Krim, *Phys. Rev. Lett.*, **102**, art# 136104 (2009)
115. “*Friction, Force Chains and Falling Fruit*”, J. Krim and R.P. Behringer, *Physics Today*, **62**, pp. 66-67 (Sept. 2009); reprinted and translated into Japanese for the Feb. 2011 issue of *Parity*
116. “*Sliding friction measurements of molecularly thin ethanol and pentanol films: How friction and spreading impact lubricity*”, B.P. Miller and J. Krim, *J. Low. Temp. Phys.*, **157** **invited**, Special issue on Wetting, Spreading, and Filling, p 252 (2009)
117. “*Nanoscale design of adaptive tribological coatings and gold-yttrium stabilized zirconia based nanocomposites*”, J. Krim, B. Dawson, K. Barefoot, C. Baker, L. Pan J. Pearson, M. Zikry, A. Voevodin, *Tribology- Materials, Surfaces and Interfaces*, **3** 145 (2009)

118. “*Tribo-induced Surface Melting at a Sliding Asperity Contact*” B.D. Dawson, S. M. Lee, and J. Krim, Phys. Rev. Lett. **103**, art# 205502 (2009)
119. “*Impact of in situ oxygen plasma cleaning on the resistance of Ru and Au-Ru based RF MEMS contacts in vacuum*”, M. Walker, C. Nordquist, N. McGruer and J. Krim, J. Applied Phys., **107**, art# 084509 (2010)
120. “*A Nano- to Macroscale Tribological Study of PFTS and TCP lubricants for Si MEMS Applications*”, B.P. Miller, N.D. Theodore, M.J. Brukman, K.J. Wahl and J. Krim, Tribology Letters, **38**, 69-78 (2010)
121. “*Temperature dependence of single-asperity friction for a diamond on diamondlike carbon interface*” C.G. Dunkle, I.B. Altfeder, A.A. Voevodin, J. Jones, J. Krim and P. Taborek, J. Applied Phys. **107**, art# 114903 (2010)
122. “*Contact voltage-induced softening of RF MEMS gold-on-gold contacts at cryogenic temperatures*”, D. Berman, M.J. Walker and J. Krim, J. Appl. Phys. **108**, art # 044307 (2010)
123. “*Evaluation of Oxygen Plasma and UV Ozone methods for cleaning of occluded area in MEMS devices*”, D. Adam Hook, J.A. Olhausen, J. Krim and M.T. Dugger, J. Micro-electromechanical Systems, **19**, 1292-1298 (2010)
124. “*Contact degradation in hot/cold operation of direct contact micro-switches*” Z. Yang, D.J. Lichtenwalner, A. Morris, J. Krim and A.I. Kingon, J. Solid Mechanics and Materials Engineering, **20**, art#105028 (2010)
125. “*Resolution of the Transfer Direction of Field Evaporated Gold Atoms*”, Z. Yang, D. Lichtenwalner, J. Krim and A. I. Kingon, Applied Physics Letters **98**, art#044102 (2011)
126. “*Stick-slip and the transition to sliding in a 2D Granular Medium and a Fixed Particle Lattice*”, J. Krim, P. Yu and R.P. Behringer, **invited**, Pure and Applied Geophysics (PAGEOPH), special issue on “*Brittle deformation of solid and granular materials with applications to mechanics of earthquakes and faults*” **168**, 2259-2275 (2011)
127. “*Electrical Contact Resistance and Device Lifetime Measurements of Au-RuO<sub>2</sub>-Based RF MEMS Exposed to Hydrocarbons in Vacuum and Nitrogen Environments*”, M.J. Walker, D. Berman, C. Nordquist and J. Krim, Tribology Lett. **44**, 305-314 (2011)
128. “*Impact of adsorbed organic monolayers on vacuum electron tunneling contributions to electrical resistance at an asperity contact*”, D. Berman, M.J. Walker, C.D. Nordquist and J. Krim, J. Applied Phys. **110** art#114307 (2011)
129. “*Friction and energy dissipation mechanisms in adsorbed molecules and molecularly thin films*”, J. Krim, **invited**, Advances in Physics, **61**, Iss. 3, 155-323 (2012)

130. *"Temperature dependence of nanoscale friction for Fe on YBCO"*, I. Altfeder and J. Krim, Journal of Applied Physics, **111**, art#094916 (2012)
131. *"Impact of oxygen and argon plasma exposure on the roughness of gold film surfaces"*, D. Berman, Thin Solid Films, **520** pp. 6201-6206 (2012)
132. *"Frictional temperature rise in a sliding physisorbed monolayer of Kr/graphene"*, M. Walker, C. Jaye, J. Krim, and M.W. Cole, Journal of Physics: Condensed Matter, **24**, art#424201 (2012)
133. *"Scanning tunneling microscope-quartz crystal microbalance study of temperature gradients at an asperity contact"*, Liming Pan and J. Krim, Rev. Sci. Instr., **84**, 014901 (2013)
134. *"Phononic and Electronic Friction"*, J. Krim, in Encyclopedia of Tribology, Q. Jane Wang and Yip-Wah Chung, eds. (Springer, NY, 2013)
135. *"Quartz Crystal Microbalance Applications to Tribology"*, B.P. Miller and J. Krim, in Encyclopedia of Tribology, Q. Jane Wang and Yip-Wah Chung, eds. (Springer, NY, 2013)
136. *"Surface Science, MEMS and NEMS: Progress and opportunities for surface science research performed on, or by, microdevices."*, D. Berman and J. Krim, Progress in Surface Science, **88** (2), 171-211, (2013) **invited**
137. *"Nanodiamond-based Nanolubricants: Experiment and Modeling"* D. Brenner, Z. Mahbooba, F. Saberi-Movahed, J. Krim, Z. Liu, M.G. Ivanov, E. Osawa and O. Shenderova (2014). MRS Proceedings, 1703, mrss14-1703-pp05-04 doi:10.1557/opl.2014.840.
138. *"Tribological properties of nanodiamonds in aqueous suspensions: effect of surface charge"*, Z. Liu, D. Leininger, A. Koolivand, A. I. Smirnov, O. Shendarova, D.W. Brenner and J. Krim, RSC Advances **5** 78933-78940 (2015)
139. *"Interactions of Antibacterial Peptides with Nanotubular Lipid Bilayers: Binding Kinetics and Distortions of the Bilayer Structure"*, Morteza Jafarabadi, Antonin Marek, Amir Koolivand, Biplav Acharya, Alexander A Nevzorov, Jacqueline Krim, Alex I Smirnov, Biophysical Journal **110** (3), 79a (2016)
140. *"Quartz Crystal Microbalance for study of viscous liquids at high temperature"*, Biplav Acharya, Meera A. Sidheswaran, Ron Yungk and Jacqueline Krim, Rev. Sci. Instr., **88**, art # 025112 (2017); doi 10.1063/1.4976024
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142. "A combined QCM and AFM study exploring the nanoscale lubrication mechanism of silica nanoparticles in aqueous suspension" B. Acharya, M. Chestnut, A. Marek, A.I. Smirnov, and Krim, *J. Tribol. Lett.* **65** (3) 115 (2017); doi:10.1007/s11249-017-0898-5.
143. "In situ, real time studies of reaction film formation temperatures for Iron, Chrome and SS304 surfaces immersed in 5% Tricresyl Phosphate in base oil," B. Acharya, TN Pardue and J. Krim, *Tribol. Int.*, **126**, 106-115 (2018)
144. "Simultaneous stress and mass change measurements arising from laser induced detuning of a quartz crystal microbalance", L. H. Goodman, E. S. Bililign, B. W. Keller, S. G. Kenny and J. Krim, *J. Appl. Phys.*, **124** (2) art# 024502 (2018).
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147. "A Tribological Study of  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> Nanoparticles in Aqueous Suspension". T.N. Pardue, B. Acharya B, .K. Curtis and J. Krim, *Tribol. Lett.* **66** (4) 130 (2018)
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149. "Tuning Nanoscale Friction by Applying Weak Magnetic Fields to Reorient Adsorbed Oxygen Molecules" Z. Fredricks, K. Stevens K, S. Kenny, B. Acharya, and J. Krim, *Condens. Matter* **4** (1) (2019); doi.org/10.3390/condmat4010001
150. "Nanotribological performance factors for aqueous suspensions of oxide particles and their relation to macroscale lubricity", B. Acharya, T.N. Pardue, L. Su, A.I. Smirnov, D.W. Brenner and J. Krim, *Lubricants* **7** (6), 49 (2019)
151. "Vibration can enhance stick-slip behavior for granular friction", A.H. Clark, R.P. Behringer and J. Krim, *Granular Matter* **21**(3):55 (2019)
152. "Synergistic effect of nanodiamonds on the adsorption of tricresyl phosphate on iron oxide surfaces", A. Khajeh, J. Krim and A. Martini, *App. Phys. Lett.* **114** (17) art#171602 (2019)
153. "Synergistic effect of nanodiamonds on the adsorption of tricresyl phosphate on iron oxide surfaces (vol 114, 171602, 2019)", A. Khajeh, J. Krim and A. Martini, *App. Phys. Lett.* **114** (21) art#219901 (2019)

154. “Dielectric and Electrostatic Properties of Silica Nanoparticle - Water Interface by EPR of pH-Sensitive Spin Probes”, V. Perelygin, M. Voinov, A. Marek, E. [SEP]Ou, Erkang, J. Krim, D. Brenner, T. Smirnova and A. Smirnov, *J. Phys. Chem C*, **123** (49), 29972-29985 (2019)
155. “Tuning friction and slip at solid-nanoparticle suspension interfaces by electric fields”, B. Acharya, C.M. Seed, D. Brenner A. Smirnov and J. Krim, *Scientific Reports*, **9** (1): 1-11 (2019) doi.org/10.1038/s41598-019054515-1
156. “Friction: Friend and Foe.”, C.K. Curtis, J.L. Streator and J. Krim, in *Surface and Interface Science, Volume 10: Applications of Surface Science II*, Klaus Wandelt ed. (Wiley, NY, 2020) pp 691-734, ISBN:9783527413812
157. “Correlation of high frequency QCM sphere-plate stiffness measurements with macroscopic frictional contacts in thin film and bulk stainless-steel materials.” C.M. Seed, B. Acharya, R. Andrus and J. Krim, *Sensors and Actuators A: Physical*, **306** art#111913 (2020) doi.org/10.1016/j.sna.2020.111913
158. “Dynamics of Neutral and Charged Nano-Diamonds in Aqueous Media Confined Between Gold Surfaces under Normal and Shear Loading”, L. Su, J. Krim and D.B. Brenner, *ACS Omega*, **5** (18): (2020) pp10349-10358 doi.org/10.1021/acsomega.0c00073
159. “Continuum model analysis of QCM nanotribological data to obtain friction coefficients for 304SS Contacts lubricated by water and TiO<sub>2</sub> nanoparticle suspensions” C.M. Seed, B. Acharya and J. Krim, *Front. Mech. Eng. (Tribology)* **7** art# 191 (2021) <https://doi.org/10.3389/fmech.2020.00072>
160. “QCM Study of Tribotronic Control in Ionic Liquids and Nanoparticle Suspensions” C.M. Seed, B. Acharya and J. Krim, *Trib. Lett.* **69** art# 83 (2021) <https://doi-org.prox.lib.ncsu.edu/10.1007/s11249-021-01461-7>
161. “Tribotronic control and energy storage attributes of metal-oxide nanofluid interfaces”, C.M. Seed, B. Acharya, V. Perelygin, A.I. Smirnov and J. Krim, submitted, under review
162. “Shear activation of ZDDP reaction films in the presence and absence of nanodiamonds” B. Acharya, C. M. Seed and J. Krim, *ACS Applied Materials & Interfaces*, submitted, under review
163. “Lubrication of MEMS devices with trace levels of ethanol vapor”, D.A. Hook, B.P. Miller, B.M. Vlastakis, M.T. Dugger, and J. Krim, imminent submission

#### **Ph. D. Dissertations:**

(1) **Eric Watts**, Rockwell International (Ph.D., Physics, 1989), “*Interfacial viscosity at the Boundary of Nitrogen and Krypton with Gold and Silver Surfaces*”



(2) **Ronald Chiarello**, Stanford Univ., (Ph.D., Physics, 1990), *"Roughness Characterization of Gold and Silver Surfaces and the Wetting behavior of Physisorbed Films Studied by a Combined Quartz Crystal Microbalance and X-Ray Reflectivity Technique"*

(3) **Vania Panella**, Max Planck Inst. (Ph.D., Physics, 1992), *"Adsorption Isotherms as Characterization of Self-affine Surface Roughness"*

(4) **George Palasantzas**, Univ. of Groningen (Ph.D., Physics, 1994), *"X-Ray reflectivity and Scanning Tunneling Microscopy Study of Kinetic Roughening of Silver Films"*

(5) **Christopher Daly**, Naval Research Laboratory (Ph.D., Physics, 1996), *"Phonon Energy Dissipation in the Nanotribology of Rare Gas Films"*

(6) **Chihong Mak**, Linear Manufacturing, LTD., Hong Kong (Ph.D., Physics, 1996), *"Quartz Crystal Microbalance Studies of the Dependence of Atomic Scale Friction on Velocity, Chemical properties and Interfacial Topology"*

(7) **Angela J. Dayo**, Northeastern Univ., (Ph.D., Physics, 1998), *"Quartz Crystal Microbalance Measurements of Electronic Contributions to Sliding Friction"*

(8) **Mohammed Abdelmaksoud**, (Ph.D., Physics, 2002), *"Nanotribology of a Vapor Phase Lubricant: Quartz Crystal Microbalance Study of Tricresylphosphate (TCP) Uptake on Iron and Chrome"*

(9) **Stephen Winder**, (Ph.D., Physics, 2003) *"Quartz Crystal Microbalance Measurements of Sliding Friction of Inert Gas Films on Lead, Copper, Nickel, and Graphene Surfaces"*

(10) **Tonya Coffey**, (Ph.D., Physics, 2004) *"Nanotribology Fundamentals: Predicting the viscous coefficient of friction"*

(11) **Matthew J. Highland**, (Ph.D., Physics, 2006) *"Superconductivity Dependent Friction"*

(12) **Cherno Jaye**, (Ph.D., Physics, 2006) *"Quartz Crystal Microbalance Studies of Atomic Scale Friction of Krypton on Graphene"*

(13) **Worakarn Neeyakorn**, (Ph.D., Physics, 2006) *"Interfacial Slippage and Friction Studies on Material of Interest to Microelectromechanical Systems (MEMS)"*

(14) **Christopher Brown** (Ph.D., Physics, 2008) *"Physics of RFMEMS switch contacts"*

(15) **Matthew James Walker** (Ph.D. Materials Science and Engineering, 2009) *"Impact of Stringently Controlled Vacuum Environments and in situ Plasma Cleaning on Contact Resistance of Au and Ru Based Radio Frequency Microelectromechanical Switches"*

(16) **Brendan Paul Miller**, (Ph.D., Physics, 2009) *"Diffusion of Physisorbed Layers and their Connection to MEMS Effectiveness"*.

(17) **Benjamin D. Dawson** (Ph.D., Physics, 2010) “*Tribo-induced temperature rise and melting at a single asperity sliding contact*”.

(18) **Liming Pan, Ph.D.**, (Ph.D., Physics, 2011), "*Tribo-induced Melting/Softening Transitions at Sliding Tungsten/Gold-Nickel Asperity Contacts*"

(19) **D. Adam Hook**, (Ph.D., Physics, 2011), "*The Physics of Vapor Phase lubrication of MEMS*"

(20) **Iyam Lynch**, (Ph.D., Physics, 2011), "*Friction and Sliding of Polystyrene Micro Particles in the Presence and Absence of Capillary Adhesion*"

(21) **Diana Berman**, (Ph. D., Physics, 2012), "*Physics of Electrical Current Flow through an Asperity in the Presence and Absence of an Adsorbed Layer*"

(22) **Zijian Liu**, (Ph.D. Physics, 2016), “*Atomic Scale Friction and Lubrication of Carbon Based Materials in Aqueous Environments*”

(23) **Zachary Fredricks**, (Ph.D., Physics, 2016), “*Quartz Crystal Microbalance Studies of Magnetic Mechanisms of Atomic-Scale Friction*”

(24) **Biplav Acharya**, (Ph.D., Physics, 2019), “*Multiscale friction and lubrication studies of water and oil based lubricants in the presence and absence of nanoparticles*”

## **POPULAR LITERATURE WRITEUPS and COVER STORIES**

(1) “*Physics Revolution Changing the Shape of Geometric Thought*”, *Boston Sunday Herald*, (November 11, 1990) by Ann Parson.

(2) “*Slippery when Dry*” *Discover magazine*, December 1994 Breakthroughs Section, by a staff reporter.

(3) “*There's the Rub*”, *The Dallas Morning News*, (August 14, 1995) Discoveries section, by Alison Mack

(4) “*Nanotribology: The Atomic-Scale Origins of Friction*”, J. Krim, in *Physics News* in 1995, P.F. Schewe and B.P. Stein, Eds. (AIP, College Park, 1995), 67-68, **invited**

(5) “*Friction at the Atomic Scale*”, J. Krim, *Scientific American*, cover story for the October 1996 issue, **275**, 74-80 (1996), **invited**

(6) “*Science Friction?*”, by Erik Stokstad, ScienceNOW website of Science Magazine, (February 23, 1998)

- (7) “*Superconductivity and Friction*”, The Economist, Science and Technology Section, **346**, 84 (Feb. 28, 1998 issue), by a staff reporter
- (8) “*Frigid Running*”, by Ivars Peterson, Science News, Physics Research Notes section, **153**, 172 (March 14, 1998)
- (9) Fortune Magazine, (Sept. 28th, 1998 Management series issue), article by Ivan Amato
- (10) “*Superconductivity-Dependent Friction*”, by P.F. Schewe, Physics Today, Update Section, **50**, 9 (April 1998 issue)
- (11) “*Rubbing and Scrubbing*”, Cover Story by G. Hahner and N. Spencer, Physics Today **51**, 22-28 (September 1998 issue)
- (12) “*There's the Rub*”, Feature story by Charles Seife, New Scientist **160**, 30-33 (October 17, 1998 issue)
- (13) “*The Little Engines that Couldn't*”, Cover Story by Peter Weiss, Science News, (June 2000)
- (14) “*A Little Friction*”, Science section of the August, 2003 issue of Popular Mechanics
- (15) “*Friction at the nanoscale*”, J. Krim, Cover story for Physics World **18**, (2): 31-34, (2005)
- (16) “*QCM tribology studies of thin adsorbed films*”, J. Krim, Nano Today 2 (5): 38-43, (2007)
- (17) “*Quantum Control of Diamond Structures*”, Science and Technology, Concentrates section, by Jyllian N. Kemsley, Chemical & Engineering News **87**, (April 13, 2009)
- (18) “*MEMS: an end to Fear of Contact*”, Cover story by Linda Day, Tribology and Lubrication Technology, **66**, 32 (2010) Reprinted in the February 2011 issue of the Japanese Journal *Parity*.
- (19) “*Friction Fighters*”, A. Lieb, PBS NOVA Next, (August 5, 2015)
- (20) “*Scientists seek Materials that defy Friction at the Atomic Level*”, Emily Conover, Science News (August 1, 2019)

## INVITED SEMINARS and COLLOQUIA

- (1) AT& T Bell Laboratories, Murray Hill, NJ; July 1983
- (2) University of Washington, Seattle, WA; Jan. 1984
- (3) Massachusetts Institute of Technology, Cambridge, MA; May 1984
- (4) University of Nice (France); Nov. 1984
- (5) University of Nancy (France); Dec. 1984

- (6) University of Liverpool (England); Jan. 1985
- (7) Saclay National Research Institute, Paris (France); Feb. 1985
- (8) University of California, Los Angeles, CA; Feb. 1985
- (9) Stanford University, Stanford, CA; Feb. 1985
- (10) Rutgers University, Piscataway, NJ; March 1985
- (11) University of Laval, Quebec City (Canada); March 1985
- (12) Northeastern University, Boston, MA; March 1985
- (13) Cornell University, Ithaca, NY; March 1985
- (14) University of Virginia, Charlottesville, VA; March 1985
- (15) Catholic University of Leuven (Belgium); May 1985
- (16) Northeastern University, Boston, MA; Nov. 1985
- (17) University of Wisconsin, Madison, WI; Dec. 1985
- (18) Wesleyan University, Middletown, CT; Feb. 1986
- (19) University of Massachusetts, Amherst, MA; Sept. 1986
- (20) IBM Watson Research Center, Yorktown Heights, NY; Dec. 1986
- (21) IBM Almaden Research Center, San Jose, CA; Feb. 1987
- (22) Rensselaer Polytechnic Institute, Troy, NY; March 1987
- (23) University of Missouri, Columbia, MO; Dec. 1987
- (24) IBM Almaden Research Center, San Jose, CA; Dec. 1987
- (25) Marlborough College, Marlborough, VT; March 1988
- (26) Ohio State University, Columbus, OH; April 1988
- (27) Clarkson University, Potsdam, NY; March 1989
- (28) University of Rhode Island, Kingston, RI; April 1989
- (29) University of Connecticut, Storrs, CT; April 1989
- (30) University of Liverpool, (England); May 1989
- (31) Massachusetts Institute of Technology, Cambridge, MA; Oct. 1989
- (32) University of California, Santa Barbara; April 1990
- (33) University of Virginia, Charlottesville, VA; Sept. 1990
- (34) Harvard University, Cambridge, MA; Oct. 1990
- (35) Brown University, Providence, RI; Nov. 1990
- (36) Brooklyn Polytechnic Institute, Brooklyn, NY; Nov. 1990
- (37) Mount Holyoke College, South Hadley, MA; Dec. 1990
- (38) Naval Research Laboratory, Washington D.C.; Feb. 1991
- (39) Brandeis University, Waltham, MA; Oct. 1991
- (40) University of South Florida, Tampa, FL; Feb. 1992
- (41) Worcester Polytechnic Institute, Worcester, MA; Feb. 1992
- (42) U. Massachusetts, Amherst, MA; Feb. 1992
- (43) I.F.F. Julich, (Germany); March 1992
- (44) University D'Aix-Marseille II, (France); June 1992
- (45) North Dakota State University, Fargo, ND; Oct. 1992
- (46) University of Missouri, Columbia, MO; Feb. 1993
- (47) University of Maine, Orono, ME; April 1993
- (48) The Aerospace Corporation, Los Angeles, CA; April 1993
- (49) Harvard University, Cambridge, MA; May 1993
- (50) Worcester Polytechnic Institute, Worcester, MA; June 1993
- (51) Northeastern University, Boston, MA; June 1993

- (52) University of Massachusetts, Lowell, MA; Oct. 1994
- (53) Sandia National Laboratory, Albuquerque, NM; March 1994
- (54) University of San Diego, La Jolla, CA; April 1994
- (55) Lawrence Berkeley Laboratory, Berkeley, CA; April 1994
- (56) Penn. State University, State College, PA; June 1994
- (57) Michigan State University, East Lansing, MI; Oct. 1994
- (58) University of Wisconsin, Madison, WI; Oct. 1994
- (59) American Vacuum Society, New England Chapter, Boston, MA; Dec. 1994
- (60) Union College, Schenectady, NY, February 1995
- (61) Kansas State University, Manhattan, March 1995
- (62) Emory University, Atlanta, GA, April 1995
- (63) Brookhaven National Laboratory, Upton, NY, July 1995
- (64) McGill University, Montreal, Canada, Sept. 1995
- (65) Clarkson University, Worcester, MA; Sept. 1995
- (66) Tufts University, Medford, MA; Oct. 1995
- (67) Northeastern University, Boston, MA; Nov. 1995
- (68) University of Houston, TX; Nov. 1995
- (69) Texas A&M University, College Station, TX; Nov. 1995
- (70) University of Connecticut, Nov. 1995
- (71) University of Maryland, Dec. 1995
- (72) University of Akron, OH, May 1996
- (73) Wesleyan University, Middletown, CT, Oct. 1996
- (74) University of Washington, Seattle, WA, Oct. 1996
- (75) Harvard University, Cambridge, MA, Nov. 1996
- (76) University of Illinois, Champagne-Urbana, IL, Nov. 1996
- (77) Massachusetts Institute of Technology, Cambridge, MA, Jan. 1997
- (78) North Carolina State University, Raleigh, NC, Feb. 1997
- (79) University of California, Berkeley, CA, Feb 1997
- (80) Ohio State University, Columbus, OH, Feb. 1997
- (81) Syracuse University, Syracuse, NY, Feb. 1997
- (82) Brown University, Providence, RI, March, 1997
- (83) Cabot, Corp., MA, March 1997
- (84) Boston University, Boston, MA, April 1997
- (85) Notre Dame University, South Bend, IN, April 1997
- (86) University of Maryland, Baltimore, MD, Feb. 1998
- (87) Wayne State University, OH, Feb 1998
- (88) University of Virginia, Charlottesville, VA, March 1998
- (89) Holyoke College/Five College Lecturer, Holyoke, MA, April 1998
- (90) US Army, Natick Research Base, Natick, MA, May 1998
- (91) Northeastern University, Boston, MA, May 1998
- (92) Massachusetts Institute of Technology, Cambridge, MA, May 1998
- (93) Rutgers University, New Jersey, October, 1998
- (94) Merideth College, Raleigh, NC, October, 1998
- (95) Lawrence Berkeley Laboratory, UC Berkeley, CA, Dec. 1998
- (96) University of New Mexico, Albuquerque, NM, Dec. 1998
- (97) University of Chicago, Chicago, IL, Jan. 1999

- (98) University of Illinois, Carbondale, Jan. 1999
- (99) Duke University, Durham, NC, Feb. 1999
- (100) Clemson University, Feb. 1999
- (101) McMaster University, March 1999
- (102) University of Waterloo, March 1999
- (103) University of North Carolina, Wilmington, April 1999
- (104) University of Wisconsin, Milwaukee, December 1999
- (105) University of North Carolina, Chapel Hill, January 2000
- (106) North Carolina State University, Nanotechnology Seminar Series, June 2000
- (107) Wake Forest University, Wake Forest, NC, October 2000
- (108) University of Tennessee, April 2001
- (109) Shaw University, Raleigh, NC, April 2001
- (110) Dartmouth College, Dartmouth, NH, May 2001
- (111) University of New Mexico, Albuquerque, August 2001 (for general audiences)
- (112) University of New Mexico, Albuquerque, August 2001 (physics department colloquium)
- (113) University of North Carolina Greensboro, October 2001
- (114) University of South Florida, Tampa, FL, October 2001
- (115) Rutgers University, Piscataway, NJ, February, 2002
- (116) Florida Atlantic University, February, 2002
- (117) Lehigh University, April 2002 (Sigma Xi Distinguished Lecture)
- (118) Southern Oregon University, May 2002 (Sigma Xi Distinguished Lecture)
- (119) University of Idaho, July 2002 (Sigma Xi Distinguished Lecture)
- (120) Fermilab, Batavia, IL, Aug. 2002
- (121) Davidson College, Sept, 2002
- (122) Illinois Wesleyan, Nov., 2002
- (123) University of Tennessee, Knoxville, Nov. 2002
- (124) Kent State University, Kent, OH, Jan., 2003
- (125) North Carolina AT&T, Greensboro, NC, Feb., 2003
- (126) Hoffman-Roche, Newark, NJ, March, 2003 (Sigma Xi Distinguished Lecture)
- (127) Eastern Michigan Univ., Ypsilanti, March, 2003 (Sigma Xi Distinguished Lecture)
- (128) Dayton University, Dayton, OH, April, 2003 (Sigma Xi Distinguished Lecture)
- (129) Georgia Technical Univ., Atlanta, GA, April, 2003
- (130) Yale University, New Haven, CT, May 2003
- (131) University of North Carolina, Chapel Hill, NC January 2004
- (132) Penn State University, State College, PA, February 2004
- (133) Montana State University, Bozeman, MT, February 2004
- (134) Georgia Tech. University, Atlanta, GA, April 2004
- (135) University of Wisconsin, Madison, WI, May 2004
- (136) Emory University, Atlanta GA, May 2005
- (137) Appalachian State University, Boone, NC, May 2005
- (138) RISE outreach program, North Carolina State Univ., Raleigh, NC, July 2005
- (139) RISE outreach program, North Carolina State Univ., Raleigh, NC, July 2006
- (140) North Carolina State University, Physics department colloquium, October 2006
- (141) Univ. of North Carolina, Chapel Hill, NC physics department colloquium, November 2006
- (142) Worcester Polytechnique Institute, Worcester, MA, physics colloquium, April 2007
- (143) Sandia National Laboratories, Albuquerque, NM, October 2007

- (144) Penn. State Physics Department, State College, PA, April 2008
- (145) GE Global Research Center, May 2008
- (146) Afton Chemical Corp., Richmond, VA, Nov, 2008
- (147) Duke University, Durham, NC, nonlinear physics seminar, Feb. 2009
- (148) Tulane University, New Orleans, LA, Dec. 2009
- (149) Oak Ridge National Laboratory, Oak Ridge, TN, April 2010
- (150) Lawrence Berkeley Laboratory, UC Berkeley, CA, May 2010
- (151) North Carolina State University, Materials Dept., Raleigh, NC, March 2011
- (152) Argonne National Laboratory, Argonne, IL, Jan. 2014
- (153) Wake Forest University, Winston-Salem, NC, Nov. 2014
- (154) Virginia Tech. University, Blacksburg, VA, March 2015
- (155) North Carolina Museum of Natural Sciences, Raleigh, NC, May 2015 (general audience)
- (156) University of Virginia, Charlottesville, VA, Nov. 2015
- (157) Central Michigan University, Mount Pleasant, MI, April 2016 (Sigma Pi Sigma keynote lecture, general audience)
- (158) Emory University, Atlanta, GA, April 2016
- (159) NCSU Physics 100 year anniversary celebration, Raleigh, NC, Nov. 2017
- (160) North Carolina State University, Physics. Dept., Raleigh, NC, Sept. 2019
- (161) Adamas Nanotechnologies virtual lecture series on Nano diamonds, Earth Day, 2021
- (162) XR Climate Science speaker series, Sept. 8, 2021

#### **INVITED PRESENTATIONS AT WORKSHOPS AND CONFERENCES**

- (1) “Characterization of Microscopic Surface Roughness with Adsorption Isotherms and X-ray Reflectivity”, “Phase Equilibria and Interfacial Phenomena”, Leuven, Belgium, (1990)
- (2) “Probing 2-D Phase Transitions and Surface Melting through Measurements of Interfacial Viscosity”, NATO advanced study institute on “*Phase Transitions in Surface Films*”, Erice, Italy (1990)
- (3) “*Interfacial Slippage and Sliding Friction of Physisorbed Monolayers*”, “*Surface Physics in Materials Science*”, El Paso, Texas (1990)
- (4) “*Characterization of Microscopic Surface Roughness with Adsorption Isotherms and X-ray Reflectivity*”, Gordon Conference on Fractals, Plymouth, New Hampshire (1990)
- (5) “*Quartz Crystal Microbalance Studies of Atomic-Scale Friction*”, General meeting of the American Physical Society, Symposium on Nanotribology Cincinnati, Ohio (1991)
- (6) “*Statics and Dynamics of Wetting Films Adsorbed on Self-Affine Surfaces*”, Fall Meeting of the Materials Research Society, Boston, MA (1991)
- (7) “*Characterization of Microscopic Surface Roughness with Adsorption Isotherms and X-ray Reflectivity*”, “*Surface Disorder: Growth, Roughening and Phase Transitions*”, Les Houches, France (1992)
- (8) “*Fractal Scaling*”, Workshop on Statistical Mechanics of Soft Condensed Matter, Florence, Italy (1992)
- (9) “*Quartz Crystal Microbalance Studies of Atomic Scale Friction*”, American Vacuum Society North Chapter Meeting, Columbus, Ohio (1992)
- (10) “*Static and Dynamic Surface Roughness in Vapor-Deposited Metal Films*”, General Meeting of the American Physical Society, Seattle (for C. Thompson) (1993)

- (11) "*Energy Dissipation Mechanisms in Atomic-Scale Friction Measurements*" Molecular Basis of Friction Symposium, Spring Meeting of the American Chemical Society, Denver, CO (1993)
- (12) "*Atomic-Scale Friction Measurements on Silver and Other Substrates*", Gordon Conference on Tribology, Plymouth NH (1994)
- (13) "*Quartz Microbalance and STM Studies of Friction for Molecularly Thin Water Films*", Gordon Conference on Water, Plymouth, NH (1994)
- (14) "*Quartz Crystal Microbalance Studies of Atomic-Scale Friction*", General Meeting of the Electrochemical Society, Miami, FL (1994)
- (15) "*Fractal Scaling at Nanometer Length-Scales*", Fall Meeting of the Materials Research Society, Boston, MA (1994)
- (16) "*Macroscopic and Microscopic Friction*", Spring Meeting of the American Chemical Society, Anaheim, CA (1995)
- (17) "*Atomic-scale Friction Measurements with a Quartz Crystal Microbalance*", ICTP Adriatic Research Conference on The Physics of Sliding Friction, Trieste, Italy (1995)
- (18) "*Nanotribology*", General Meeting of the American Physical Society, San Jose, CA (1995)
- (19) "*Phonon and Electronic Contributions to Wearless Friction*", Workshop on Physical and Chemical Mechanisms in Tribology, Bar Harbor, ME (1995)
- (20) "*Scanning Probe Microscopy Characterizations of Thin Film Growth*", *Second Workshop on Science and Technology of Thin Films*", Trieste, Italy (1996)
- (21) "*Electron and Phonon Contributions to Friction*", Surface Analysis '96, Ann Arbor, MI (1996)
- (22) "*Friction on Disordered Surfaces*", Gordon Conference on Order/Disorder in Solids, New London, NH (1996)
- (23) "*Electron and Phonon Contributions to Friction*", VIII Int. Conf. on Vibrations at Surfaces, University of Birmingham, UK (1996)
- (24) "*Friction, Avalanches and Arching*", Julich, Germany (1996)
- (25) Workshop on Mechanics of MEMS, Berkeley, CA (1997)
- (26) *Disorder-Induced Lubrication*, 13th Symposium on Thermophysical Properties, Boulder, CO (1997)
- (27) Royal Society of Chemistry Faraday Discussion 107 on Acoustic Waves, Leicester, UK (1997)
- (28) NSF/AFOSR Workshop on MEMS/Tribology, Columbus, OH, Nov. 1997
- (29) New England Electrochemical Society Local Symposium, Boston, MA, Dec. (1997)
- (30) Gordon Conference on Chemistry at Interfaces, July (1998)
- (31) 14th Int. Vacuum Congress 10th Int. Conf. Solid Surfaces 5th Int. Conf Nanometer Scale Sci. & Technol. 10th Int. Conf. Quant. Surf. Analysis, Birmingham, UK, Sept. (1998)
- (32) American Vacuum Society National Symposium, Topical Conference on the Science of MEMS, Baltimore, MD, Nov. (1998)
- (33) American Vacuum Society National Symposium, Job Information Forum speaker, representing academia, Baltimore, MD, Nov. (1998)
- (34) Triangle Area Meeting of the Materials Research Society, Research Triangle Park, North Carolina, November, (1998)
- (35) American Chemical Society, Fundamental Studies of Molecular Tribology Symposium, Anaheim, CA, March (1998)
- (36) Materials Research Society Symposium on Tribology, San Francisco, CA, (June (1998)
- (37) Gordon Research Conference on Dynamics at Surfaces, Andover, NH, (August 1998)
- (38) Complex Fluid Interfaces, Pisa, Italy, Sept. 1999



- (39) Acoustic Wave Sensor Workshop, Wasserburg, Germany, (Sept. 1999)
- (40) Dynamics Days 2000, Los Alamos, NM, Jan. (2000)
- (41) American Chemical Society, San Francisco, CA , (March 2000)
- (42) Joint Israel-North Carolina Workshop on MEMS, Haifa, Israel, (May 2000)
- (43) 14th Symposium on Thermophysical Properties, Boulder, CO, (June 2000)
- (44) Material Research Society Symposium P on Growth, Evolution and Properties of Surfaces, Boston, MA, (Nov. 2000)
- (45) VII International Summer School, “*Nicolas Cabrera*” on Imaging and Manipulation of Matter, Madrid, Spain, (Sep. 2000)
- (46) 8th Foresight Conference on Molecular Nanotechnology, Bethesda, MD, (Nov. 2000)
- (47) Euresco Conference on Electronic Structure, “*Out of the Vacuum*”, Touloun, France, (September 2001)
- (48) Acoustic Wave Workshop, Taos, NM (August 2001)
- (49) AFOSR/ONR/NSF Tribology Review, Duck Key, Fl, (June 2001)
- (50) American Association of Physics Teachers, Morehead City, NC, (October 2001)
- (51) American Chemical Society, Symposium on Friction, Orlando, FL., (April 2002)
- (52) European Physical Society, Brighton, Great Britain, (April 2002)
- (53) AFOSR Tribology&Quasicrystal Program Review, (June 2002)
- (54) International Workshop on Materials for Extreme Environments, Anchorage, AL, (Aug. 2002)
- (55) European Science Foundation Workshop on Nanotribology, Portovenere, Italy, (Oct. 2002)
- (56) National Symposium of the American Vacuum Society, Denver, CO, (Nov. 2002)
- (57) Workshop on Fundamentals of Friction, Oak Ridge, TN, (March 2004)
- (58) NSF Sponsored Workshop on Frontiers of Fundamental Tribological Research
- (58) AFOSR Tribology Program Review, (Nov 2004)
- (60) Nanosikkim II, Friction and Biotribology, (Nov. 2004)
- (61) DARPA workshop on the Fundamental Science of RF MEMS, Santa Barbara, CA (May 2005)
- (62) Workshop on Earthquakes, Friction and Fracture, UC Santa Barbara, CA (August 2005)
- (63) World Tribology Congress III, Washington DC, (Sept 2005)
- (64) AFOSR Tribology Review, (Oct. 2005)
- (65) NCSU Nanodays 2006, Raleigh, NC (Feb. 2006)
- (66) Gordon Conference on Tribology, Colby College, (June 2006)
- (67) AFOSR Tribology review, Dayton, OH, (Aug. 2006)
- (68) American Association Physics Teachers, National symposium, Seattle, WA, Jan 2007
- (69) Transforming Higher Education: Building a Women's Agenda, NCSU, Feb. 2007
- (70) Multiscale Approaches to Nanomechanics, Lyon, France, Feb. 2007
- (71) STLE-Detroit section technical meeting, Detroit, MI, April 2007
- (72) ECS National meeting, symposium on Fullerenes, Nanotubes, and Carbon Nanostructures - Solid State Physics, Chicago, IL, May 2007
- (73) NC MEMCAP, Duke University, Durham, NC, May 2007
- (74) AVS National Symposium, Tribology of MEMS symposium, Seattle, WA, Oct. 2007
- (75) AFOSR Tribology review, Gainesville, FL, Nov. 2007
- (76) 13<sup>th</sup> Workshop on Dynamical Phenomenon at Surfaces, Cambridge, England, June 2008
- (77) Plenary lecturer, Viennano09 - 3rd Vienna Int. Conference on Nano Technology, March 2009
- (78) Keynote lecturer, Advances in Boundary Lubrication and Boundary Surface Films, International Engineering Conference, Seville, Spain, April 2009
- (79) Keynote lecturer, Trends in Nanotribology, Trieste, Italy, October 2009

- (80) SCOPE Academy, Raleigh, NC, April 2010
- (81) American Physical Society, Dallas, TX, March 2011
- (82) International Forum on Sliding Friction and Vibration, Carbondale, IL, April 2011
- (83) 10th International Conf. on the Structure of Surfaces (ICSOS-10), Hong Kong, Aug. 2011
- (84) Conference on Nanotribology, Trieste, Italy, September 2011
- (85) Society of Tribology and Lubrication Engineers (STLE) 2012 Annual meeting, Nanotribology Education Program, St. Louis, MO, May, 2012
- (86) 19th International Vacuum Conference IVC, Paris, France, September, 2013
- (87) Spring MRS Meeting, Advances in Scanning Probe Microscopy for Material Research Symposium, San Francisco, CA, April, 2014
- (88) Lou Bruch Symposium, University of Wisconsin, Madison, May, 2014
- (89) David Adler Lectureship Award, APS March Meeting, March 2015
- (90) Keynote lecture, Second International Workshop on Understanding and Controlling Nano and Mesoscale Friction, Riga, Latvia, July 2016
- (91) Gordon Conference on Tribology, June 2018, Lewiston, ME
- (92) Society of Tribology and Lubrication Engineers (STLE) 2019 Annual meeting, Nanotribology Education Program, Nashville, TN, May, 2019
- (93) Keynote lecturer, TU Berlin, Germany 14-17 Oct 2019: Contact Mechanics and Friction, Foundations and Applications
- (94) Keynote Lecturer, NCSU Physics Fest, Nov. 2019
- (95) Keynote Lecturer, International Conference on Programmable Materials, 27-29 April, 2020, Berlin, Germany (cancelled)
- (96) International Conference on Materials and Systems for Sustainability (ICMaSS), Nov. 2021, Nagoya, Japan
- (97) Mesoscopic Triboelectricity - From Patches to Particles to Planets, Bad Honnef, Germany, January 2022

**RESEARCH FUNDING (Prior and actively funded awards: \$12.9M)**

*"Growth Properties of Adsorbed Films"*, Northeastern U. Internal, \$4000.(9/1/86 – 8/31/87) J. Krim, sole PI

*"Wetting and Adsorption Properties of Physisorbed Films on Metals"*, Research Corp., \$9975, (9/1/86 – 8/31/87) J. Krim, sole PI

*"Presidential Young Investigator Award"*, National Science Foundation, \$312,500, NSF Presidential Young Investigator Award (7/1/87 – 6/30/92) J. Krim, sole PI

*"Porosity Characterization in Sputter-Deposited Films"*, IBM Corp., \$100,651 (7/1/87 – 6/30/89) J. Krim, sole PI

*"Interfacial Viscosity Measurements of Adsorbed Monolayers on Metal Surfaces"*, Office of Naval Research, \$99,291 (7/1/89-6/30/91) J. Krim, sole PI

*“Adhesion Measurements of Physisorbed Layers on Metal Surfaces”*,  
Office of Naval Research, \$93,856 (7/1/91-6/30/93) J. Krim, sole PI

*“Investigation of Self-Affine Surface Fractals through Adsorption Isotherms”*,  
National Science Foundation, \$35,500.(7/1/89 – 6/30/90) J. Krim, sole PI

*“Investigation of Self-Affine Surface Fractals through Adsorption Isotherms”*,  
Petroleum Research Fund, \$40,000. (9/1/90-8/31/92) J. Krim, sole PI

*“Quartz Crystal Microbalance Studies of Atomic-Scale Friction”*, National Science Foundation,  
\$1,612,595. (7/1/92 – 6/30/08), J. Krim, sole PI

*“Adsorption and Scanning Tunneling Microscopy on Rough Surfaces”*, NATO International  
Scientific Exchange Programs, \$7,600. (7/1/91-6/30/93) J. Krim, sole PI

*“Dynamic Scaling of Self-Affine Fractal Surfaces”*, Petroleum Research Fund, \$50,000 (9/1/92-  
8/31/94) J. Krim, sole PI

*“In-Situ Atomic-Scale Reaction Kinetics under Tribological Conditions”*,  
National Science Foundation, Surface Energy and Tribology Program (SGER),  
\$48,357. (7/1/96-6/30/97) J. Krim, sole PI

*“Vapor-phase Lubricants: Nanometer Scale Mechanisms and Applications to Sub-micron  
machinery”*, Air Force Office of Scientific Research J. Krim, sole PI \$332,570 (12/31/97 -  
11/30/00)

*“Lubricants for Extreme Environments An Atomistic Approach to Solving Friction and Stiction in  
Micro-Electro-Mechanical”*, National Science Foundation, \$449,938.00 (09/15/2000 - 08/31/2004)  
co-PI with C. Grant

*“Vapor-Phase Lubricants: Nanometer-Scale Dynamics and Applications to Sub-Micron  
Machinery”*, US Air Force, J. Krim, sole PI \$337,402.00 (01/01/2001 - 12/31/2003)

*“Combined Experimental & Theoretical Study of Tribochemistry at the Nanometer Scale with  
Application to Nano-Mechanical Devices”*, US Dept. of Energy, \$600,000.00 (09/15/2001-  
09/30/2005) Co-PI with D. Brenner

*“Acquisition of a Scanning Probe System for Characterization of Nanostructure Properties”*,  
National Science Foundation, \$450,000.00 (08/01/2003 - 07/31/2005) 5 co-PI's. RJ Nemanich, lead

*“Multi-functional Extreme Environment Surfaces: Nanotribology for Air and Space”*,  
US Air Force ,MURI \$4,947,012 (05/15/04 - 5/14/10) J. Krim, lead PI of a team of 12 co-PI's

*“Hydrodynamic Lubrication in Fiber Processing”*, NCSU National Textile Center Program, W.  
Kraus, lead PI with 2 co-PI's J. Krim portion \$168,780 (05/01/2006 – 12/31/08)

*“Center for RF MEMS Reliability and Design Fundamentals”*, University of California - San Diego G. Rebiez, lead PI , DARPA, J. Krim portion \$351,000(09/13/2006 - 09/12/2009)

*“Basic Mechanism by which Detergents Keep Fuel Injectors Clean Using Quartz Crystal Microbalance Method”* Afton, Corp. \$50,000. (8/24/2009 – 9/15/2011) J. Krim, sole PI

*“Quartz Crystal Microbalance Studies of Atomic Scale Friction”*, National Science Foundation, J. Krim sole PI (7/1/08-7/31/14), \$780,000, including a two year Creativity extension as an American Competitiveness and Innovation (ACI) Fellow.

*“Collaborative Research Proposal: Conference for Undergraduate Women in Physics on January 15-16, 2011”*, National Science Foundation \$7000, (1/1/2011-12/31/2011) J. Krim, PI, K. Daniels co-PI

*“Collaborative Research Proposal: Conference for Undergraduate Women in Physics”*, DOE (Prime) \$11,800. (1/14/2011-6/23/2011) J. Krim, co-PI

*“Interdisciplinary Studies of Bio-Nano Interfaces”* University Global Partnership Network (UGPN), \$30,000, (7/1/2012 – 6/30/2013) J. Krim, T. Smirnova, A.I. Smirnov

*“Quartz Crystal Microbalance Studies of Atomic Scale Friction”*, National Science Foundation, J. Krim sole PI (7/1/13-6/30/17), \$420,000.

*“Atomic scale friction measurements in liquid environments”* J. Krim, Sole PI, Eastman Chemical Company, (1/1/2016 – 8/15/2016) \$64,869.

*“DMREF: Designing Material-Liquid-Nanoparticle Interfaces for Tribological Control”* National Science Foundation, D. Brenner, J. Krim, A.I. Smirnov, B. Reich (8/15/2015 – 9/30/2021) \$1,502,223.