

## Curriculum Vitae

Ellen D. Williams

Department of Physics  
University of Maryland  
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### EDUCATION

Ph.D. in Chemistry, September 1981  
California Institute of Technology, Pasadena, CA 91125  
Thesis Topic: Studies of Chemical Adsorption Using Low Energy Electron Diffraction  
Thesis Advisor: Dr. W. H. Weinberg  
  
B.S. in Chemistry, June 1976,  
Michigan State University, East Lansing MI 48824

### AWARDS

American Physical Society – David Adler Lectureship Award, 2001  
Distinguished University Professor, 2000  
American Physical Society Centennial Speaker (1998-9)  
University of Maryland Distinguished Faculty Research Fellow (1996-1998)  
Japan Society for the Promotion of Science Fellow (1996)  
E.W. Mueller Award, University of Wisconsin-Milwaukee, 1996  
University of Maryland Outstanding Woman of the Year, 1996  
Fellow of the American Vacuum Society, 1993  
Fellow of the American Physical Society, 1993  
American Physical Society - Maria Goeppert - Mayer Award, 1990  
Office of Naval Research Young Investigator, 1986-1989  
Presidential Young Investigator, 1984-1989  
Cottrell Research Grant, 1983  
IBM Graduate Fellowship, 1979-80  
National Science Foundation Fellowship, 1976-79  
Alumni Distinguished Scholars Scholarship, Michigan State University, 1972-76

## **EMPLOYMENT**

Distinguished University Professor, 2000-present

Professor, 1991-present

Department of Physics, and  
Institute for Physical Science & Technology  
University of Maryland

Director, 1993-1995

Chemical Physics Program  
University of Maryland

Associate Professor, 1990-1991

Institute for Physical Science and Technology  
University of Maryland

Associate Professor, 1987-1991

Department for Physics and Astronomy  
University of Maryland

Assistant Professor, 1983-1987

Department for Physics and Astronomy  
University of Maryland

Research Associate, 1981-1983

Department for Physics and Astronomy  
University of Maryland  
Advisor: R. L. Park

Graduate Research Assistant, 1977-81

California Institute of Technology

Teaching Assistant, 1976-79

California Institute of Technology

Summer Research, 1976

Kodak Research Laboratories  
Rochester, New York

Summer Research, 1974

Miles Laboratories  
Ames Research Laboratories  
Elkart, Indiana

## **AFFILIATIONS**

Phi Beta Kappa, Sigma Xi, American Physical Society, American Vacuum Society,  
Materials Research Society.

## PROFESSIONAL ACTIVITIES

Director, NSF-Materials Research Science and Engineering Center, University of Maryland, 1996-2005

Member, NNSA Advisory Committee, 2001-present

Editorial Board, Nano Letters (ACS), 2001-present

Member Solid State Sciences Committee, Board on Physics and Astronomy (NAC), 2001-2004

Member, National Security Panel of University of California President's Council, 2000-present

Member of JASON, 1993-present

Chairman of the Gordon Conference on Thin Films and Crystal Growth, July 2001

Organizer of Greater Washington Nanoscience Openhouse at University of Maryland, October 2001 (University of Maryland, Naval Research Laboratory, and National Institute of Standards and Technology Open House series)

American Physical Society, Adler Award Selection Committee, 2001

Meeting Chair, Materials Research Society, Fall 1999

American Physical Society, Davison Germer Prize Selection Committee  
Member 1996; Chair 1998

External Advisory Committee for the University of Chicago MRSEC, 1997-2000

Co-Organizer of Materials Research Society Symposium, Mechanisms and Principles of Epitaxial Growth in Metallic Systems, Spring 1998

External Review of the NIST Nanomanufacturing of Atom Based Standards Project, NIST, Gaithersburg, MD, August 1996

Editorial Board, Surface Science, 1995-2001

Co-organizer, Materials Research Society Symposium, Evolution of Thin Film and Surface Morphology, Fall 1996

Member at Large, Executive Committee of the Division of Condensed Matter Physics, American Physical Society, 1994-1997

Principal Investigator: NSF Materials Research Group, 1991-1996

Co-Organizer, Materials Research Society Symposium, Evolution of Thin Film and Surface Morphology, Fall 1994

Forum on Science in the National Interest, 1994

Co-Organizer, Workshop on New and Emerging Techniques for Imaging Surfaces, Washington, D.C., 1993

Editorial Board, Review of Scientific Instruments, 1991-1993

American Physical Society Committee on the Status of Women in Physics, 1990-1992

Co-Chairman, Local Arrangements Committee, Physical Electronics Conference, 1990

Executive Committee, Surface Science Division of the American Vacuum Society, 1989-1990

Local Arrangements Committee, 33rd National Symposium, American Vacuum Society,  
Baltimore, 1986

Rapporteur for the National Academy of Science Research Briefing on Selected  
Opportunities in Physics, 1984

Reviewer for NSF, DOE, Israel Science Foundation, Surface Science, Physical Review B,  
Physical Review Letters, Journal of Vacuum Science and Technology, Applied  
Physics Letters, Science, Nature

## DISSERTATIONS SUPERVISED

- Yves U. Idzerda, "Interacting Thin-Film Systems Probed by Electron-Induced Extended Fine Structure," Ph.D. May 1986.
- Tim R. Ohno, "Reaction of Arsenic and Nickel with Vicinal Silicon Surfaces: A LEED/AES Study," Ph.D. May 1989.
- Yu-Nong Yang, "Study of High-Index Silicon Surfaces," Ph.D. May 1990.
- Xue Sen Wang, "Construction of a Scanning Tunneling Microscopy and Application to Vicinal Si (111) Surfaces," Ph.D. August 1990.
- Romel Gomez, "Facetting of Vicinal Si(111): Design and Application of the Scanning Tunneling Microscope," Ph.D. December 1990.
- Jill Goldberg, "Statistical Mechanics of Steps Studied Using scanning Tunneling Microscopy," Ph.D. June 1992.
- Timothy Jung, "LEED Studies of Vicinal Semiconductor Surfaces," (co-advisor R.J. Phaneuf).Ph.D. June 1992.
- Jian Wei, "Studies of Equilibrium Properties of Steps and Kinks Using High-Resolution LEED," Ph.D. in Chemical Physics, June 1992.
- Kai-Tak Wan, "Relationship Between Fundamental Intersurface Forces and Fracture Properties of Brittle Materials," (Advisor: Brian Lawn, NIST), Ph.D. in Chemical Physics, June 1993.
- Bin Li, "Studies of Oxidation and Thermal Equilibrium on Vicinal Si Surfaces," Ph.D. December 1993.
- Elain Fu, "Characterization and Fabrication of Nano- and Micron-sized Structures on the Si Surface using Scanning Probe Microscopies," Ph.D. August 1997.
- Vincent Tsai, "Calibration of Atomic Force Microscopes with Silicon Step Artifact," (Advisor: T. Vorburger, NIST), Ph.D. in Materials Science, May 1998.
- Erika Jones, "Design of Sample Templates for Doping Characterization," M.S. in Chemical Physics May 1999.
- Robert Ryland, "Application and Development of Scanning Tunneling Microscopy Techniques" Ph.D. August 2001.
- Jonathan McCoy, "Bayesian Solutions to the Deconvolution Problem," (co-advisor, R. Pego, Applied Mathematics) M.S. in Applied Mathematics, August 2001.
- Ruchirej Yongsunthon, "Magnetic Force Microscopy for Observation of Current Crowding in Electromigration Phenomena," Ph.D August 2002.
- Karen Siegrist, "Characterization of Contrast Mechanisms of the Photoelectron Emission Microscope," Ph.D. December 2002.

## PUBLICATIONS

1. "A Determination of Adatom-Adatom Interaction Energies: Application to Oxygen Chemisorbed on the Tungsten (110) Surface," *J. Vacuum Sci. Technol.* 15, 417 (1978); *J. Chem. Phys.* 68, 4688 (1978), (E.D. Williams, S. L. Cunningham and W.H. Weinberg).
2. "A Structural Determination of the Unreconstructed and the Reconstructed (110) Surfaces of Iridium," *J. Vacuum Sci. Technol.* 16, 642 (1979), (C.-M. Chan, K.L. Luke, M.A. Van Hove, E.D. Williams and W.H. Weinberg).
3. "The Geometric Structure of Carbon Monoxide Chemisorbed on the Ruthenium (001) Surface at Low Temperatures," *Surface Sci.* 82, 93 (1979), (E.D. Williams and W.H. Weinberg).
4. "Structural Study of the Reconstructed Ir(110)-(1x2) Surface by Low Energy Electron Diffraction," *Solid State Commun.* 30, 47 (1979), (C.-M. Chan, M.A. Van Hove, W.H. Weinberg and E.D. Williams).
5. "The Adsorption of Sulfur on the Reconstructed Ir(110)-(1x2) Surface," *Surface Sci.* 81, L309 (1979), (E.D. Williams, C.-M. Chan and W.H. Weinberg).
6. "Debye Temperatures of the (110) and (111) Surfaces of Iridium Determined by LEED," *Surface Sci.* 82, L577 (1979), (C.-M. Chan, E.D. Williams and W.H. Weinberg).
7. "The Chemisorption of CO on Rh(111)," *Surface Sci.* 84, 54 (1979), (P.A. Thiel, E.D. Williams, J.T. Yates and W.H. Weinberg).
8. "An R-Factor Analysis of Several Models of the Reconstructed Ir(110)-(1x2) Surface," *Surface Sci.* 91, 440 (1979), (C.M. Chan, M.A. Van Hove, W.H. Weinberg and E.D. Williams).
9. "Does Chemisorbed Carbon Monoxide Dissociate on Rhodium?" *Surface Sci.* 91, 562 (1980), (J.T. Yates, E.D. Williams and W.H. Weinberg).
10. "Segregation of Co-absorbed Species: Hydrogen and Carbon Monoxide on the Rh(111) Surface," *Chem. Phys.* 72, 3496 (1980), *AIP Conference Proceedings: Aspects of the Kinetics and Dynamics of Surface Reactions*, ed. Uzi Landman, American Institute of Physics, New York, 1980, p. 275 (E.D. Williams, W.H. Weinberg, and J.T. Yates).
11. "Computations of Profiles of Low-Energy Electron Diffraction Beams for Arrays of Ordered Islands," *Proceedings of the Fourth International Conference of Solid Surfaces*, p. 311 (1980); *Surface Sci.* 109, 574 (1984), (E.D. Williams and W.H. Weinberg).
12. "CO on Ru(001), Island Size and Disorder," *J. Chem. Phys.* 76, 1150 (1982), *J. Vacuum Sci. and Technol.* 20, 534 (1982), (E.D. Williams, W.H. Weinberg, and A. C. Sobrero).
13. "Reply to Comments on 'Does Chemisorbed Carbon Monoxide Dissociate on Rhodium?'" *Surface Sci.* 115, L93 (1982), (J.T. Yates, E.D. Williams and W.H. Weinberg).
14. "A Model for the Saturated Water Bilayer on Ru(001) Based on a Comparison of Experimental and Calculated LEED Patterns," *J. Vacuum Sci. Technol.* A1, 1188 (1983), (E.D. Williams and D.L. Doering).

PUBLICATIONS (continued)

15. "Relationship between Many-Parameter Lattice Gas Systems and Simpler Models: Easy Approximations for  $T_c$ ," J. Vacuum Sci. Technol. A2, 1188 (1984), (N. C. Bartelt, T.L. Einstein and E.D. Williams).
16. "Electron Energy Loss Study of the Epitaxial Growth of Cu on W(110)," Surface Sci. 148, 453 (1984), (J. Vahakangas, H. Iwasaki, E.D. Williams and R.L. Park).
17. "Precursor Adsorption of CO on Ni(111) near 5 K and the Activation Energy for Chemisorption," Surface Sci. 154, L239 (1985), (M. Shayegan, E.D. Williams, R.E. Glover III and R.L. Park).
18. "Two-dimensional Ordering of Chlorine on Ag(100)," Phys. Rev. B 32, 4653 (1985); J. Vacuum Sci. Technol. A2, 895 (1984), (D.L. Taylor, E.D. Williams, N.C. Bartelt, R.L. Park and T.L. Einstein).
19. "Surface Extended Electron Loss Fine Structure: Dependence on Incident Electron Energy and Collection Solid Angle," Surface Sci. 160, 75 (1985), (Y.U. Idzerda, E.D. Williams and R.L. Park).
20. "On the Detailed Growth Mode of Thin Silver Films on Si(111)," Surface Sci. 172, 433 (1986), (Q.-G. Zhu, A.-D. Zhang, E.D. Williams and R.L. Park).
21. "Growth and Alloying of Ti on Cu(111)," Phys. Rev. B 33, 2281 (1986), (J. Vahakangas, E.D. Williams and R.L. Park).
22. "The initial growth of Ti on Si," Phys. Rev. B 33, 8716 (1986), (J. Vahakangas, Y.D. Idzerda, E.D. Williams and R.L. Park).
23. "Formation of Iron Silicide Thin Films," J. Appl. Phys. 60, 2629 (1986), (Q.-G. Zhu, H. Iwasaki, E.D. Williams and R.L. Park).
24. "Initial Formation of Titanium Silicide," Surface Science 177, L1028 (1986), (Y.U. Idzerda, J. Vahakangas, E.D. Williams and R.L. Park).
25. "Reaction and Structure of Ti on Si: Probed by SEELFS and EAPFS," J. Vac. Sci. Technol. A5, 847 (1987) (Y.U. Idzerda, T.L. Einstein, E.D. Williams and R.L. Park).
26. "Low-Energy Electron Transmission through Cu/Ni Quantum Wells," J. Vac. Sci. Technol. A5, 2065 (1987); Phys. Rev. Lett 58, 2563 (1987) (Q.-G. Zhu, A.-D. Zhang, E.D. Williams and R.L. Park).
27. "Influence of Surface Steps on the Growth of Epitaxial  $NiSi_2$ ," J. Vac. Sci. Technol. A5, 2143 (1987); and Appl. Phys. Lett. 50, 754 (1987) (G. Akinici, T. Ohno and E.D. Williams).
28. "Comparison of High-Temperature and Laser-Quenched Si(111)," Phys. Rev. B 35, 4155 (1987), (R.J. Phaneuf and E.D. Williams).

PUBLICATIONS (continued)

29. "Metastable Structures of Si(111) Formed by Laser-Quenching," *Surface Sci.* 195, 330 (1988), (R.J. Phaneuf and E.D. Williams).
30. "Surface Phase Separation of Vicinal Si(111)," *Phys. Rev. Lett.* 58, 2563 (1987), (R.J. Phaneuf and E.D. Williams).
31. "Electron-Induced Extended Fine Structure Measurements of Thin Film Growth and Reactions," *Phys. Rev. B* 36, 5941 (1987), (Y.U. Idzerda, E.D. Williams, T.L. Einstein and R.L. Park).
32. "NiSi<sub>2</sub> on Si(111): I. Effects of Substrate Cleaning Procedure and Reconstruction," *Surface Sci.* 193, 534 (1988), (G. Akinci, T. Ohno and E.D. Williams).
33. "Temperature Dependence of the Phase Diagram of Cl/Ag(100)," *Phys. Rev. B.* 37, 5870 (1988), (R.Q.Hwang, E.D. Williams, N.C. Bartelt and R.L. Park).
34. "NiSi<sub>2</sub> on Si(111): II. Effects of Substrate Temperature and Defect Structure," *Surface Sci.* 201, 27 (1988), (G. Akinci, T.R. Ohno and E.D. Williams).
35. "Thermal Disordering of the ( $\sqrt{3} \times \sqrt{3}$ ) R30° Structure of Al on Si(111)," *Surface Sci.* 193, L53 (1988), (R.Q. Hwang, E.D. Williams, N.C. Bartelt and R.L. Park).
36. "The Temperature Dependence of Vicinal Si(111) Surfaces," *Phys. Rev. B* 38, 1984 (1988); *Proceedings of the 2nd International Conference on the Structure of Surfaces*, eds, J.F. van der Veen and M.A. Van Hove, Springer-Verlag, Berlin (1987), p. 525, (R.J. Phaneuf, N.C. Bartelt and E.D. Williams).
37. "Defect Sensitivity of the Growth of Nb on Si(111)," *Solid State Commun.*, 68, 145 (1988), (S.R. Mahamuni, D.T. Abell and E.D. Williams).
38. "Appearance Potential Study of Ba-Activated Oxidation of Ni," *Surface Sci.* 206, 289 (1988), (R. Gomez and E.D. Williams).
39. "Temperature-Orientation Phase Diagram of Vicinal Si(111): Relationship Between (7x7) Reconstruction and Range of Unstable Orientations," *Nucl. Phys. B. (suppl.)* 5A, 300 (1988), (R.J. Phaneuf, E.D. Williams, N.C. Bartelt and T.L. Einstein).
40. "Comparisons of LEED and STM Measurements of Vicinal Si(111)," *J. Microsc.*, 152, 473 (1988), (X.-S.Wang, R.J. Phaneuf and E.D. Williams).
41. "Orientational Stability of Silicon Surfaces," *J. Vacuum Sci. Technol.* A7, 1898 (1989), (N.C. Bartelt, E.D. Williams, Y. Yang, R.J. Phaneuf and S. Das Sarma).
42. "Carbon-Induced Facetting of Si(112)," *Surface Sci.*, 215, 102 (1989), (Y. Yang and E.D. Williams).

PUBLICATIONS (continued)

43. "Surface Facetting and The Equilibrium Crystal Shape," *Ultramicroscopy* 31, 36 (1989), (E.D. Williams and N.C. Bartelt). (Review Article)
44. "Comment on 'Kinetics and Reconstruction of Steps at the Si(001) Surface'," *Phys. Rev. Lett.* 65, 1285 (1990), (Y. Yang and E.D. Williams).
45. "A High-Resolution Low-Energy Electron Diffraction Instrument," *Rev. Sci. Instrum.* 60, 2945 (1989); *J. Vac. Sci. Technol. A2*, 1004 (1984), (R.Q. Hwang, E.D. Williams and R.L. Park).
46. "High Resolution LEED Study of the Phase Diagram of Vicinal Si(111) Surfaces," *Phys. Rev. B* 40, 11716 (1989), (R.Q. Hwang, E.D. Williams and R.L. Park).
47. "Arsenic-Induced Facetting of Vicinal Si(100) Surfaces," *Jpn. J. of Appl. Phys.* 28, L2061(1989), (T.R. Ohno and E.D. Williams).
48. "A Step-Height Tripling Transition on Vicinal Si(111)," *Phys. Rev. B* 41, 2991 (1990), (R.J. Phaneuf and E.D. Williams).
49. "Arsenic-Induced Step Rearrangement on Vicinal Si(111) Surfaces," *Appl. Phys. Lett.* 55, 2628 (1989), (T.R. Ohno and E.D. Williams).
50. "The Role of Carbon in the Facetting of Silicon Surfaces on the (111) to (100) Azimuth," *J. Vac. Sci. Technol. A8*, 2481 (1990), (Y. Yang and E.D. Williams).
51. "Disordering of the (3x1) Reconstruction on Si (113) and the Chiral Three-State Potts Model," *Phys. Rev. Lett.* 64, 2410 (1990); *The Structure of Surfaces III*, Eds., M.A. Van Hove et al. (Springer, Berlin, 1991), (Y. Yang, E.D. Williams, R.L. Park, N.C. Bartelt, and T.L. Einstein).
52. "Step Structure and Interface Morphology: Arsenic on Vicinal Silicon Surfaces," *J. Vac. Sci. Technol. B8*, 874 (1990), (T.R. Ohno and E.D. Williams).
53. "Terrace Width Distributions on Vicinal Si(111)," *Phys. Rev. Lett.* 65, 2430 (1990), (X.-S. Wang, J.R. Goldberg, N.C. Bartelt and E.D. Williams).
54. "The Precipitation of Kinks on Stepped Si(111) Surfaces," *The Structure of Surfaces*, Eds. M.A. Van Hove et al. (Springer, Berlin 1991); *J. Chem. Phys.*, 94, 8384 (1991), (J. Wei, X.-S. Wang, N.C. Bartelt, E.D. Williams and R.T. Tung).
55. "Diffraction from Stepped Surfaces in Thermal Equilibrium," *Surface Sci.* 244, 149 (1991), (N.C. Bartelt, T.L. Einstein, and E.D. Williams).
56. "The Influence of Step-Step Interactions on Step Wandering," *Surface Sci.* 240, L591 (1991), (N.C. Bartelt, T.L. Einstein and E.D. Williams).

PUBLICATIONS (continued)

57. "Quantization of Terrace Widths on Vicinal Si(111)," J. Vacuum Sci. Technol. A9, 1868 (1991), (J. Goldberg, X.-S. Wang, J. Wei, N.C. Bartelt and E.D. Williams).
58. "Thermodynamics of Surface Morphology," Science 251, 393 (1991), (E.D. Williams and N.C. Bartelt). (Review Article)
59. "Low Energy Electron Diffraction Study of the Reconstruction and Orientational Stability of Si(331)," Surface Sci. 250, L368 (1991), (J. Wei, E.D. Williams and R.L. Park).
60. "Stability of the Si-YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-x</sub> Interface," J. Materials Res., 6, 1634 (1991), (B. Li and E.D. Williams).
61. "Surface Height Correlation Functions of Vicinal Si(111) Surfaces Using Scanning Tunneling Microscopy," Surface Sci. 249, L285 (1991), (J.L. Goldberg, X.S. Wang, N.C. Bartelt and E.D. Williams).
62. "Step Structure and Reconstruction on Vicinal Ge(111) Surfaces," Surface Sci. 254, 235 (1991), (T.M. Jung, R.J. Phaneuf and E.D. Williams).
63. "LEEM Investigation of Orientational Phase Separation on Vicinal Si(111)," Phys. Rev. Lett. 21, 2986 (1991), (R.J. Phaneuf, N.C. Bartelt, E.D. Williams, W. Swiech and E. Bauer).
64. "Step-Height Mixtures on Vicinal Si(111) Surfaces," Phys. Rev. Lett. 68, 3885 (1992), (J. Wei, X.S. Wang, J.L. Goldberg, N.C. Bartelt and E.D. Williams).
65. "LEEM Investigation of the Domain Growth of the 7x7 Reconstruction on Si(111)," Surface Sci. 268, 227 (1992), (R.J. Phaneuf, N.C. Bartelt, E.D. Williams, W. Swiech and E. Bauer).
66. "Step Doubling and Related Transitions on Vicinal Surfaces," J. Vacuum Sci. Technol. A10, 2600 (1992), (T.L. Einstein, T.M. Jung, N.C. Bartelt, E.D. Williams and C. Rottman).
67. "The Role of Step Collisions on Diffraction from Vicinal Surfaces," Surface Sci. 276, 308 (1992), (N.C. Bartelt, T.L. Einstein and E.D. Williams).
68. "The Equilibration of Terrace Width Distribution on Stepped Surfaces," Surface Sci. 273, 252 (1992), (N.C. Bartelt, J.L. Goldberg, T.L. Einstein and E.D. Williams).
69. "The Role of Surface Stress in the Facetting of Stepped Si(111) Surfaces," Mat. Res. Soc. Symp. Proc. 238, 219 (1992), (E.D. Williams, R.J. Phaneuf, N.C. Bartelt, W. Swiech, and E. Bauer).
70. "Step Structure on Si(111) Surfaces," Proceedings of the Workshop on Surface Disorder, Eds. R. Jullien, J. Kertesz, P. Meakin and D.E. Wolf, Nova Science Publishers, NY, 1992, p. 103, (E.D. Williams and N.C. Bartelt).

PUBLICATIONS (continued)

71. "Thermodynamics and Statistical Mechanics of the Facetting of Stepped Si(111)," Surface Sci. 294, 219 (1993), (E.D. Williams, R.J. Phaneuf, J. Wei, N.C. Bartelt and T.L. Einstein).
72. "Crossover from Metastable to Unstable Facet Growth on Si(111)," Phys. Rev. Lett. 71, 2284 (1993), (R.J. Phaneuf, N.C. Bartelt, E.D. Williams, W. Sweich and E. Bauer).
73. "Sublimation and Phase Transitions on Singular and Vicinal Si(111)," Surface Sci. 301, 129, (1994), (T. Jung, R.J. Phaneuf and E.D. Williams).
74. "The Brownian Motion of Steps on Vicinal Si(111)," Phys. Rev. B48, 15453 (1993), (N.C. Bartelt, T.L. Einstein, E.D. Williams, J.-J. Métois, J.C. Heyraud, J.L. Goldberg).
75. "Surface Steps and Surface Morphology: Understanding Macroscopic Phenomena from Atomic Observations," Surface Sci. 299/300, 502 (1994), (E.D. Williams). (Review Article).
76. "Temperatures of Enhanced Stability in Hot Thin Plasmas," Astrophysical Journal 418, L25 (1993), (N. Gehrels and E.D. Williams).
77. "The Contact Angles of Trapped Steps on Faceted Si(111)," Chem. Phys. Lett., 217, 595 (1994), (B. Li, N.C. Bartelt and E.D. Williams).
78. "High Atom Density in the "1x1" Phase-Origin of the Metastable Reconstructions on Si(111)," Phys Rev. Lett. 72, 1862 (1994), (Y.-N. Yang and E.D. Williams).
79. "Measuring Surface Mass Diffusion Coefficients by Observing Step Fluctuations," Surface Sci. 312, 411 (1994), (N.C. Bartelt, T.L. Einstein and E.D. Williams)
80. "Theory of Surface Electromigration on Metals," Surface Sci. 315, L995, (1994), (P.J. Rous, T.L. Einstein and E.D. Williams).
81. Erratum to "Thermodynamics and Statistical Mechanics of the Facetting of Stepped Si(111)," Surface Sci. 310, 451 (1994), (E.D. Williams, R.J. Phaneuf, J. Wei, N.C. Bartelt and T.L. Einstein).
82. "Step Capillary Waves and Equilibrium Island Shapes on Si(001)," Phys. Rev. Lett. 73, 1656, (1994) (N.C. Bartelt, R.M. Tromp and E.D. Williams).
83. "Interface Roughening in Surfactant Deposition," Applied Phys. Lett. 25, 2609 (1994), (S. Hasegawa, R. Ryland and E.D. Williams).
84. "Metastable Reconstructions on Si(111)," Scanning Microscopy 8, 781 (1995), (Y.N. Yang and E.D. Williams).
85. "Energetics of Steps on Vicinal Si(111) using Empirical Potentials," Phys. Rev. B57, 5200 (1995), (S. Kodiyalam, K.E. Khor, N.C. Bartelt, E.D. Williams and S. Das Sarma).
86. "Domain Boundary Induced Metastable Reconstructions During Epitaxial Growth Si/Si(111)," Phys Rev. B51, 13238 (1995), (Y.-N. Yang and E.D. Williams).

PUBLICATIONS (continued)

87. "Thermodynamics and Statistical Mechanics of Surfaces," in Handbook of Surface Science, Vol. I, W.N. Unertl, Ed., Elsevier: Amsterdam, 1996, p. 51-99, (E.D. Williams and N.C. Bartelt). (Review Article)
88. "Measurement of the Anisotropy Ratio During Current-Induced Step Bunching," Surface Sci. 336, L746 (1995), (E.D. Williams, E. Fu, Y.-N. Yang, D. Kandel and J.D. Weeks).
89. "Silicon Motion During Antimony Deposition on Si(111)," Surface Sci. 345, 222 (1995), (R. Ryland, S. Hasegawa and E.D. Williams).
90. "New and Emerging Techniques for Imaging Surfaces," Critical Reviews in Surface Chemistry, 5(4) 275-303 (1995), (E. D. Williams and L. D. Marks).
91. "An STM Study of Current-Induced Step Bunching on Si(111)," Surface Sci. 356, 101-111 (1996), (Y.-N. Yang, E. Fu and E.D. Williams).
92. "Evolution of Si Surface Nanostructure under Growth Conditions," in Low Dimensional Structures prepared by Epitaxial Growth or Regrowth on Patterned Structures, K. Eberl, Ed. 1995, Kluwer Academic: The Netherlands. p. 185-195 (R.J Phaneuf, H.-C. Kan and E.D. Williams).
93. "Progress on Accurate Metrology on Pitch, Height, Roughness, and Width Artifacts Using an Atomic Force Microscope," SPIE 2439, 401 (1995), (J. Schneir, T. McWaid, R. Dixon, V.W. Tsai, J.S. Villarrubia, E.D. Williams and E. Fu).
94. "Size-Scaling in the Decay of Metastable Structures," Phys. Rev. Lett. 77, 1095-8 (1996), (E. Fu, M.D. Johnson, E.D. Williams, D. Liu and J.D. Weeks).
95. "Relaxation of the Step Profile for Different Microscopic Mechanisms," Journal of Vacuum Science and Technology B14, 2799-2808 (1996), (D.-J. Liu, E.S. Fu, M.D. Johnson, J.D. Weeks, and E.D. Williams).
96. "Finish and Figure Metrology for Soft X-Ray Optics" in U.S.-Japan Workshop on Soft X-Ray Optics (1996). Yamanaka-ko, Japan (T.V. Vorburger, C.J. Evans, V. Tsai, J. Fu, E.D. Williams, R. Dixon, P.J. Sullivan, and T. McWaid.).
97. "Two Dimensional Facet Nucleation and Growth on Si(111)," Phys. Rev. B55, 7653-7659 (1997), (D.-J. Liu, J.D. Weeks, M.D. Johnson and E.D. Williams).
98. "The Effective Charge in Surface Electromigration," Surface Science, 385, 259-269 (1997), (E.S. Fu, D.-J. Liu, M.D. Johnson, J.D. Weeks and E.D. Williams).
99. "Characterization of pn Junctions and Surface States on Silicon Devices by Photo Emission Electron Microscopy," Applied Physics A 64, 423-430 (1997), (M. Giesen, R.J. Phaneuf, E.D. Williams, T.L. Einstein and H. Ibach).
100. "Growth of Si on the Si(111) Surface," Phys. Rev. B. 57, 13132-13148 (1998), (C.J. Lanczycki, Y.-N. Yang, E. Fu, R. Kotlyar, E.D. Williams, and S. Das Sarma).
101. "Conformal Oxides on Si Surface," Appl. Phys. Lett. 71, 1495-1497 (1997), (V. Tsai, X.-D. Wang, E.D. Williams, T.V. Vorburger, R. Dixon, J. Fu, J. Schneir and T. McWaid).

PUBLICATIONS (continued)

102. "Evolution of Morphology During Etching of Si," Materials Research Society Symposium Proceedings, 466, 157-166 (1997), (E.D. Williams, E.S. Fu and B. Li).
103. "Step Structures on Br-Chemical Vicinal Si(111)," Surface Sci. 400, 220-231 (1998), (X.-S. Wang and E.D. Williams).
104. "Dynamics of Step Bunching During Faceting of Vicinal Si(113) Studied by STM," Scanning Microscopy, in press, 1998, (K. Sudo, T. Yoshinobu, H. Iwasaki, and E.D. Williams).
105. "Photoelectron Emission Microscopy of Schottky Contacts," Surface Science 396, 411-421 (1998), (M. Giesen, R. J. Phaneuf, E.D. Williams, and T.L. Einstein).
106. "Imaging the Depletion Zone in a Si Lateral pn Junction with Scanning Tunneling Microscopy," Applied Physics Letter, 72, 3314-3316 (1998), (M. Hildner, R.J. Phaneuf, and E.D. Williams).
107. "Evolution of Surface Morphology of Vicinal Si(111) Surfaces after Aluminum Deposition," Surface Science 418, 22-31 (1998), (C. Schwennicke, X.-S. Wang, T.L. Einstein and E.D. Williams).
108. "Nanostructure Evolution and Electromigration on Silicon: Experimental Application of Length-Scaling Predictions," Solid State Comm. 107, 681-691 (1998), (E.D. Williams) (Review Article).
109. "Step Fluctuations on Vicinal Si(113)," Physical Review Lett. 80, 5152-5155 (1998), (K. Sudo, T. Yoshinobu, H. Iwasaki, E.D. Williams).
110. "Steps on Surfaces: Experiment and Theory," Surface Sci. Reports 34, 171-294, 1999, (H.-C. Jeong and E.D. Williams). (Review Article).
111. "Nonuniversality in Mound Formation during Semiconductor Growth," Phys. Rev. B60, R8469-8472 (1999). (G. Lengel, R.J. Phaneuf, E.D. Williams, S. Das Sarma, W. Beard and F.G. Johnson).
112. "Characterization of Structures Fabricated by AFM Lithography," Surface Sci. 438 58-67, 1999, (E.S. Fu, X.-S. Wang and E.D. Williams).
113. "Scaling of Ferroelectric Properties in Thin Films," Appl. Phys. Lett. 75 402-10 (1999). (C.S. Ganpule, A. Stanishevsky, Q. Su, S. Aggarwal, J. Melngailis, E.D. Williams, and R. Ramesh).
114. "Nanoscale Fluctuations at Solid Surfaces," Physics Today 52 24-28 (1999) (Z. Torozckai and E.D. Williams). (Review Article).
115. "Onset of Step Anti-banding Instability due to Surface Electromigration," Physical Rev. Lett. 83 5531-4 (1999) (K. Thürmer, D.-J. Liu, J.D. Weeks and E.D. Williams).
116. "Spontaneous Ordering of Oxide Nanostructures," Science 287, 2235-2237 (2000) (S. Aggarwal, A.P. Monga, S.R. Perusse, R. Ramesh, V. Ballarotto, E.D. Williams, B.R. Chalamala, Y. Wei and R.H. Reuss).

PUBLICATIONS (continued)

117. "Facet Growth due to Attractive Step-Step Interactions on Vicinal Si(113)," *Surface Sci.* 452, L287-L292 (2000) (K. Sudoh, H. Iwasaki and E.D. Williams).
118. "Decay of Silicon Mounds: Scaling Laws and Description with Continuum Step Parameters," *Applied Surface Science* **175-176**, 33-5 (2001) (A. Ichimiya, K. Hayashi, E.D. Williams, T.L. Einstein, M. Uwaha, and K. Watanabe).
119. "Variation of Threshold Field in Field-Induced Fabrication of Au Nanodots on Ultrathin in-situ Grown Silicon Oxide," *Surface Sci.* 470 L69-74, 2000 (J.-Y. Park, R.J. Phaneuf, and E.D. Williams)
120. "PEEM Imaging of Dopant Contrast on Si(001)," *Surface Sci.* 461, L570-574, 2000 (V. Ballarotto, K. Siegrist, R.J. Phaneuf, E.D. Williams, and S. Mogren).
121. "Domain nucleation and relaxation kinetics in ferroelectric thin films," *Applied Physics Letters* **77** 3275-3277, 2000 (C.S. Ganpule, V. Nagarajan, S.B. Ogale, A.L. Roytburd, E.D. Williams, and R. Ramesh).
122. "Decay of Silicon Mounds: Scaling Laws and Description with Continuum Step Parameters," *Physical Review Letters* 84 3662-6, 2000 (A. Ichimiya, K. Hayashi, E.D. Williams, T.L. Einstein, M. Uwaha, and K. Watanabe).
123. "Scanning Tunneling Spectroscopy of Field-Induced Au Nanodots on Ultrathin Oxides on Si(001), *Journal of Vacuum Science and Technology* **B19** 523-6, 2001 (J.-Y. Park, R.J. Phaneuf and E.D. Williams).
124. "Initial Stage of In-phase Step Wandering on Si(111) Vicinal Surfaces," *Surface Science* **487**, 171-179, 2001, (M. Degawa, K. Thuermer, I. Morishima, H. Minoda, K. Yagi and E.D. Williams).
125. "Continuous and discontinuous transitions on 3D equilibrium crystal shapes: A new look at Pb and Au," *Surface Science* **481** 13-24, 2001 (A. Emundts, H.P. Bonzel, P. Wynblatt, K. Thürmer, J. Reutt-Robey, and E.D. Williams).
126. "Calibrated MFM Measurement of Current-Carrying Lines," *Journal of Vacuum Sci. and Technol.* **A19**, 1763-8, 2001 (R. Yongsunthon, J. McCoy, E.D. Williams).
127. "Observation of Current Crowding near Fabricated Voids in Au Lines," *Applied Physics Letters* 78, 2661-3, 2001, (R. Yongsunthon, A. Stanishevsky, J. McCoy, E.D. Williams).
128. "Photon-Energy Dependence of Contrast in Photoelectron Emission Microscopy of Semiconductor Devices", *Applied Physics Letters* **78** 3547-9, 2001 (V.W. Ballarotto, K. Siegrist, R. Phaneuf, and E.D. Williams).
129. "Step Dynamics in 3D Crystal Shape Relaxation," *Physical Review Letters*, **87** 186102-4, 2001 (K. Thuermer, J. Reutt-Robey, E.D. Williams, M. Uwaha, A. Emundts and H.P. Bonzel).
130. "Polarization Relaxation Kinetics and 180° Domain Wall Dynamics in Ferroelectric Thin Films," *Physical Review* **B65** 014101-6, 2001 (C.S. Ganpule, B.K. Hill, A.L. Roytburd, V. Nagarajan, E.D. Williams, R. Ramesh, and J.F. Scott).

PUBLICATIONS (continued)

131. "Step Wandering on Al/Si(111) surface at high temperature," *Surface Science* **429**, L671-6, 2001 (I. Lyubinetzky, D. Daugherty, H.L. Richards, T.L. Einstein, and E.D. Williams).
132. "Silicon single atom steps as AFM height standards," *Proceedings SPIE* 4344, 157, 2001 (R. Dixon, N.G. Orji, J.Fu, V. Tsai, E.D. Williams, R. Kacker, T. Vorburger, H. Edwards, D. Cook, P. West, and R. Nyffenegger).
133. "Direct Imaging of a Biased pn Junction with Conductance Mapping", *Journal of Applied Physics* **91** 3745, 2001 (J.-Y. Park, R.J. Phaneuf, and E.D. Williams)
134. "A Model for Doping-Induced Contrast in PEEM," *J. Applied Physics* 91 469-475, 2002 (V.W. Ballarotto, K. Siegrist, R.J. Phaneuf, and E.D. Williams).
135. " Dynamics of step fluctuations on a chemically heterogeneous surface of Al/Si(111)- ( $\beta \infty \beta$ )," *Physical Review B* 66, 85327-31, 2002 (I. Lyubinetzky, D.B. Dougherty, T.L. Einstein and E.D. Williams).
136. "Green's Function Propagation of Magnetic Force Microscopy Data," *Journal of Applied Physics* 92, 156-61, 2002 (R. Yongsunthon, E.D. Williams, J. McCoy, R. Pego, P. Rous).
137. "Experimental Persistence Probability for Fluctuating Steps," *Physical Review Letters* **89**, 36144-7, 2002 (D.B. Dougherty, I. Lyubinetzky, E.D. Williams, M. Constantin, C. Dasgupta, and S. Das Sarma).
138. "Magnetic Force Microscopy Signatures of Defects in Current-carrying Lines," *Materials Research Society Symposium Proceedings* 699, 107-112, 2002 (R. Yongsunthon, E.D. Williams, A. Stanishevsky, P. Rous, J. McCoy, and R. Pego).
139. "Autocatalytic Oxidation of Lead Crystallite Surfaces," *Science* **297**, 2033-5, 2002 (K. Thürmer, E.D. Williams and J. Reutt-Robey).
140. "Si(111) Step Fluctuations at High Temperature: Anomalous Step-Step Repulsions," *Physical Review B* 66, 115310-5, 2002 (S.D. Cohen, R.D. Schroll, T.L. Einstein, J.-J. Métois, H. G. Bantu, H.L. Richards, and E.D. Williams).
141. "Photoelectron Emission Microscopy of Ultra-Thin Oxide Covered Devices," *Journal of Vacuum Science and Technology* 20, 2514-18, 2002 (V. Ballarotto, M. Breban, K. Siegrist, R.J. Phaneuf, and E.D. Williams).
142. "Nucleation Limited Crystal Shape Transformations," *Surface Science*, in press 2002 (K. Thürmer, J.E. Reutt-Robey and E.D. Williams).
143. "Phase Imaging of Buried Structures," *Applications of Surface Science*, in press 2002 (R. Yongsunthon, P.J. Rous, A. Stanishevsky, K. Siegrist, and E.D. Williams).
144. "Persistence Exponents for Step Edge Diffusion," *Surface Science* in press, 2002 (D.B. Dougherty, O. Bondarchuk, M. Degawa, and E.D. Williams).
145. "Mapping Electron Flow Using Magnetic Force Microscopy," *Applied Physics Letters*, submitted 2002 (R. Yongsunthon, E.D. Williams, A. Stanishevsky, and P.J. Rous).

PUBLICATIONS (continued)

146. "Characterizing topography-induced contrast in photoelectron emission microscopy," *Journal of Vacuum Science and Technology* submitted, 2002 (K. Siegrist, E.D. Williams, and V. Ballarotto).
  147. "Magnetic Force Microscopy Imaging of Current Paths," *Materials Research Society Symposium Proceedings* submitted, 2002 (R. Yongsunthon, E.D. Williams, A. Stanishevsky, and P. Rous).
  148. "A study of photoelectron emission microscopy contrast mechanisms relevant to microelectronics," submitted *ISTFA*. 2002 (V. Ballarotto, K. Siegrist, E.D. Williams, and W. Vanderlinde.)
  149. "Early Stages of Thermal Evolution of Supported Pb Crystallites", in preparation, 2003 (D.B. Dougherty, K. Thürmer, M. Degawa, W.G. Cullen, J.E. Reutt-Robey, and E.D. Williams).
  150. "Step Fluctuations on a Multiple Phase Al/Si(111) Surface," in preparation, 2003 (D.B. Dougherty, I. Lyubinetsky, T.L. Einstein, and E.D. Williams).
  151. "Dewetting Dynamics of Ultrathin Silver Films on Si(111)," submitted 2003 (K. Thürmer, E.D. Williams and J.E. Reutt-Robey).
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## INVITED TALKS AND COLLOQUIA (9/95 through present)

92. **Thermodynamics and Kinetics of Surface Morphology**, Physics Department Colloquium, University of Virginia, September 1995.
93. **Mobility and Metastability on Silicon Surfaces**, Materials Science Department Colloquium, Johns Hopkins University, October 1995.
94. **Thermodynamics and the Evolution of Nanostructure on Silicon Surfaces**, Physics and Chemistry of Semiconductor Interfaces, San Diego, January 1996.
95. **Creating and Using Novel Step Morphologies on Silicon Surfaces**, March Meeting of the American Physical Society, March 1996.
96. **Mobility and Metastability on Silicon Surfaces**, Materials Research Lecture, California Institute of Technology, Pasadena, California, April 1996.
97. **Evolution and Decay of Metastable Structures on Si(111)**, Physical Electronics Conference, Boston, June 1996.
98. **Predicting Mass Transport for the Stability of Nanostructures**, Physics Colloquium, Cornell, October 1996.
99. **Anomalous Effects in Growth**, Condensed Matter Seminar, Cornell, October, 1996.
100. **Acceleration of Mass Transport with Direct Current on Si(111)**, Materials Research Society, December, 1996.
101. **Equilibrium Morphology and Morphological Transitions**, Mueller Award Lecture, University of Wisconsin-Milwaukee, January 1997.
102. **Equilibrium Fluctuations and Rates of Mass Transport**, Mueller Award Lecture, University of Wisconsin-Milwaukee, January 1997.
103. **Evolution of Morphology from Nanometers to Microns**, Mueller Award Lecture, University of Wisconsin-Milwaukee, January 1997.
104. **Potential Applications of Surface Studies to Electromigration**, Lucent-Bell Labs technical seminar, January 1997.
105. **Electromigration on Si Surfaces**, 23rd Japan-U.S. Seminar, Nagoya, Japan, March 1997.
106. **Nanostructure and Step Dynamics**, Annual Meeting of the Physical Society of Japan, Nagoya, Japan, March 1997.
107. **Evolution of Nanostructure via Step Motion**, Annual Meeting of the Japanese Society of Applied Physics, Tokyo, Japan, April 1997.
108. **The Mesoscale Approach to Surface Nanostructure**, James Franck Institute Colloquium, University of Chicago, May 1997.
109. **Surface Nanostructure**, Gordon Conference on Thin Films and Crystal Growth Mechanisms, New Hampshire, July 1997.
110. **Nanostructure Evolution and Electromigration on Silicon: Experimental Applications of Length-Scaling Predictions Advancing Frontiers of Condensed Matter Science**, University of Pennsylvania, October 13-14, 1997.

INVITED TALKS AND COLLOQUIA (continued)

111. **Understanding and Controlling Surface Nanostructure**, Johns Hopkins University, Condensed Matter Seminar, October 22, 1997.
112. **Fluctuations in Materials Science**, Physics Department Colloquium, University of Maryland, March 1998.
113. **Stability and Aging of Nanostructures on Si**, Materials Research Society Meeting, San Francisco, April 1998.
114. **Equilibrium Fluctuations and the Prediction of Structural Stability**, Physics Colloquium, University of Illinois, September 1998.
115. **Quantifying Surface Electromigration: Si(111) as a Model System**, Physics Colloquium, Carnegie Mellon University, October 1998.
116. **Quantifying Surface Electromigration: Si(111) as a Model System**, 45<sup>th</sup> International American Vacuum Society Symposium, Baltimore, November 1998.
117. **Step Energies and Electromigration Patterns**, International Symposium on Surfaces and Interfaces, Tokyo Institute of Technology, November 1998.
118. **Small Structures on Si Surfaces: Characterizing Stability and Electronic Structure**, Physics Seminar, Joint Research Center on Atom Technology, Tsukuba, Japan, November 1998.
119. **Patterns and Rates in sub-micron Scale surface Restructuring**, Materials Research Society Meeting, Boston, December 1998.
120. **Designing Smart Experiments to Predict Materials Behavior: Examples from the Electromigration of Silicon**, Physics Colloquium, Johns Hopkins Applied Research Laboratory, January 1999.
121. **Fluctuations in Materials: Stability and Aging**, East-West Surface Science Workshop, Pamporovo, Bulgaria, February 1999.
122. **Equilibrium Fluctuations and the Prediction of Structural Stability**, Physics Colloquium, Princeton University, March 1999.
123. **Characterization and Comparison of Advanced Microscopies**, SEMATECH Analytical Managers Working Group Meeting, NIST, April 1999.
124. **Equilibrium Fluctuations and the Prediction of Structural Stability**, Condensed Matter Physics Seminar, Technion, Haifa, May 1999.
125. **Equilibrium Fluctuations and the Prediction of Structural Stability**, Department of Physics and Complex Systems, Weizmann Institute of Science, Rehoboth, May 1999.
126. **From Steps to the Meso-Scale: Experimental Observations on Si(111) and (113)**, International Conference on Stepped Surfaces, Wohldenber, Germany, September 1999.
127. **From Steps to the Meso-Scale: Experimental Observations on Si(111) and (113)**, Forschungszentrum, Jülich, September, 1999.

INVITED TALKS AND COLLOQUIA (continued)

128. **Equilibrium Fluctuations and the Prediction of Structural Stability**, Physics Colloquium, Vanderbilt University, February 2000.
129. **Nano-scale to Micron Scale Structural Stability**, Physics Colloquium, Vanderbilt University, Nashville, February 2000.
130. **Nano-scale to Micron Scale Structural Stability**, Condensed Matter Physics Seminar, Case-Western Reserve, Cleveland, May 2000.
131. **Fluctuations and Stability of Nanoscale Structures**, International Symposium on Surface and Interface-Properties of Different Symmetry Crossing, Nagoya, Japan, October 2000.
132. **Molecular Electronics**, Laboratory for Physical Science Colloquium, October 2000.
133. **Fluctuations and Stability of Nanoscale Structures**, Fall Meeting of the MRS, Boston, December 2000
134. **Nanoscale Fluctuations on Solid Surfaces**, American Association for the Advancement of Science, San Francisco, February 2001
135. **Interdisciplinary research using advanced surface science instrumentation**, NSF Workshop: Analytical Instrumentation for the New Millenium - Materials, New Orleans, March 2001
136. **Surface Fluctuations on Nanoscale Structures**, American Physical Society, David Adler Award Lecture, Seattle, March 2001.
137. **Nanoscale Fluctuations on Solid Surfaces**, Physics Department Colloquium, University of Maryland, March 2001.
138. **Nanoscale Fluctuations on Solid Surfaces**, Arthur M. Sackler Colloquia of the National Academy of Sciences, Washington, D.C., May 2001.
139. **Structural Fluctuations and Structural Evolution**, Materials Research Society, Boston, December, 2001.
140. **Fluctuations and Relaxation of Small Structures: Workshop on Morphological Evolution of Crystalline Surfaces**, Rosh Pina, Israel, May 2002 (workshop cancelled).
141. **Fluctuations of Nanoscale Structures: Integrated Nanosystems 2002**, Berkeley, California, September 2002.
142. **Continuum Step Dynamics: Deterministic and Stochastic Processes**: University of Leiden, Condensed Matter Physics Seminar, December 2002.
143. **Nanoscale Fluctuations on Solid Surfaces: Dutch Condensed Matter Physics Conference**, Veldhoven, The Netherlands, December 2002 (Plenary talk).

## EDUCATIONAL SERVICE

1. **Research Tutorial: Surface Science**, American Association of Physics Teachers summer meeting, June 1984.
2. **How Flat is a Surface?, Thank Goodness it's Physics Seminar**, Eleanor Roosevelt High School, December 1984.
3. **Creating New Materials Via Epitaxial Growth**, AAPT Physics Teaching Resource Agents Program, July 1986.
4. **Epitaxy and Scanning Tunneling Microscopy**, Physics Olympiad Training Program, University of Maryland, University of Maryland, July 1987.
5. **Epitaxy and Scanning Tunneling Microscopy**, AAPT/Physics Olympiad Enrichment Seminar, University of Maryland, July 1988.
6. **Scanning Tunneling Microscopy**, Physics Department, Towson State University, October 1988.
7. **Nanofabrication and Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, May 1988.
8. **Organized First APS-CSWP Site Visit**, University of Maryland Physics Department, 1990.
9. **Seeing Atoms: Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, May 1990.
10. **Scanning Tunneling Microscopy**, AAPT U.S.-Soviet Exchange Visit Seminar, August 1990.
11. **Seeing Atoms: Applications and Implications**, National Science Teachers Association's Area Convention, Washington D.C., December 1990.
12. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Haverford College, April 1991.
13. **Scanning Tunneling Microscopy - Science and Applications**, Physics Olympiad Enrichment Seminar, June 1991.
14. **Essay: Scanning Tunneling Microscopy, in Physics**, 3rd Ed. By P.A. Tipler, Worth Publishers, New York, 1991.
15. **APS (CSWP) Site Visit to Rensselaer Polytechnic**, March 1992.
16. **Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, June 1992.
17. **Seeing Atoms: Applications and Implications**, NSF Science Teaching Institute in the Rockies, Montana State University, July 1992.
18. **Experimental Statistical Mechanics on Silicon Surfaces**, NSF Faculty Enrichment Workshop, Montana State University, July 1992.

EDUCATIONAL SERVICE (continued)

19. **Laboratory Tours**, University of Maryland High-School Outreach Program, July 1992.
20. **APS (CSWP) Site Visit to the University of Illinois**, Urbana, November 1992.
21. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Mid-Atlantic and Southeastern Regional Meeting of the ACS, Washington D.C., December 1992.
22. **Seeing Atoms with the Scanning Tunneling Microscope**, U. of Wisconsin-Madison Introductory Physics Enrichment Seminar, February 1993.
23. **Applications and Implications of Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, May 1993.
24. **APS (CSWP) - AAPT Site Visit to Kansas State University**, Manhattan, Kansas, September 1993.
25. **Women in Physics**, MITRE Technical Women's Group Seminar, MITRE Corporation, McLean, Virginia, November 1993.
26. **Sigma Gamma Tau Panel Discussion on DOD-Sponsored Research at Universities**, Engineering College, University of Maryland, February 24, 1994.
27. **Press Briefings for the American Physical Society**, March Meeting, March 18 and 24, 1994.
28. **APS (CSWP) - AAPT Site Visit to State University of New York- Stony Brook**, April 1994.
29. **Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, June 1994.
30. **Scanning Tunneling Microscopy and Surface Physics**, Physics Graduate Student Association Seminar Series, Physics Department, University of Maryland, College Park, February 1995.
31. **Space for Women, Space for All: A Symposium on Careers in the Physical Sciences**, Discussion Panel Member, University of Maryland, College Park, March 11, 1995.
32. **Scanning Tunneling Microscopy**, Physics Department Seminar, Towson State University, October 1995.
33. **Workshop on Scanned Probe Microscopies**, American Association of Physics Teachers, August, 1996.
34. **Discovery and Development of Scanning Tunneling Microscopy**, Freshman Physics Seminar, October, 1996.
35. **Thermodynamics Review, GRE preparation workshop**, University of Maryland, October, 1996.
36. **Doing Experimental Statistical Mechanics on a Surface**, Graduate Seminar: Foundations and Frontiers of Physics, U. of Maryland, December 1996.

EDUCATIONAL SERVICE (continued)

37. **Seeing Atoms - Science and Applications with Scanned Probe Microscopies**, Physics Olympiad, U. of Maryland, June 1997.
38. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Physics Olympiad Enrichment Seminar, U. of Maryland, June 1997.
39. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, MRSEC-REU students, U. of Maryland, July 1997.
40. **Laboratory Tours for High School Seniors in Physics**, U. of Maryland, November 1997.
41. **Preparing for the Science Fair**, Kettering Middle School Parents Meeting, November 1997.
42. **Science Fair Mentoring**, Kettering Middle School, Nov.-Dec. 1997
43. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Freshman Physics Survey Course, U. of Maryland, November 1997.
44. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Innovations in Science Education Seminar, U. of Maryland, November 1997.
45. **Science Fair Judging**, Kettering Middle School, February 1998.
46. **Judge at MRSEC-Kettering Student Science Conference**, April 23, 1998
47. **Fluctuations on Surfaces**, Physics Department Seminar, Towson State University, February, 1998.
48. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Physics Olympiad Enrichment Seminar, University of Maryland, June 1998.
49. **Preparing for the Science Fair**, Paint Branch High School Parents' Meeting, October 1998.
50. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, College Park Scholars Science and Technology Program, October 1998.
51. **Laboratory Tours for High School Seniors In Physics**, University of Maryland, November 1998.
52. **Developing a Science Fair Project**, Kettering Middle School, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> period classes, December 1, 15 and 21, 1998.
53. **Judge at MRSEC-APS Student Science Conference**, April, 1999.
54. **Science Fair Parents' Meeting**, Kettering Middle School, October, 1999.
55. **Nanostructures on Surfaces**, Graduate Student Frontiers of Physics Seminar, October 1999.
56. **Laboratory Tours for High School Seniors In Physics**, University of Maryland, November 1999.

EDUCATIONAL SERVICE (continued)

57. **Seeing Atoms and Doing Science with the Scanning Tunneling Microscope**, Freshman Survey Physics Course, U. of Maryland, November 1999.
58. **Developing a Science Fair Project**, Kettering Middle School, Saturday Workshops (2), November 1999.
59. **Panelist on Diane Rehm Radio Talk Show, "Nanotechnology,"** January 18, 2000
60. **Science Fair Judging**, Greenbelt Middle School, February 2000.
61. **Congressional Visits Day**, participant, April 4-5, 2000.
62. **Judge at MRSEC-APS Student Science Conference**, May, 2000
63. **Seeing Atoms: Scanning Tunneling Microscopy**, Physics Olympiad Enrichment Seminar, May 2000.
64. **From Then to Now - Scanned Probe Microscopy**, REU Science Enrichment Seminar, June 2000.
65. **GRE Review for Physics Majors - Thermodynamics**, October 2000.
66. **Seeing Atoms and Doing Science with Scanning Tunneling Microscopy:** Freshman Survey Physics Course, U. of Maryland, November 2000.
67. **Science Fair Parents' Meeting**, Kettering Middle School, December, 2000.
68. **Science Fair Judging**, Greenbelt Middle School, December 2000.
69. **Excel Workshop**, Greenbelt Middle School, January, 2001.
70. **Students Lunch with the Experts**, American Physical Society, March Meeting, Seattle, March 2001
71. **Materials Science at the Nanoscale**, College Park Scholars, University of Maryland, April 2001.
72. **Seeing Atoms...Touching Atoms...Pushing Atoms Around**, University of Maryland Senior University, May 2001.
73. Judge at the **"NSF-MRSEC-APS Student Science Conference**, American Institute of Physics, College Park, May 2001.
74. **Seeing Atoms...Touching Atoms...Pushing Atoms Around**, Physics Olympiad Students, May 2001.
75. **Electrostatics and Magnetism**, Hands on Presentation for Homeschool students, University of Maryland, December 2001
76. **Science Fair Judging**, Greenbelt Middle School, January 2002.
77. **Materials Science at the Nanoscale**, Presentation and Lab Tour for ENMA 698T, Special Problems in Materials Science, Nanotechnical Characterization, University of Maryland, February 2002.

EDUCATIONAL SERVICE (continued)

78. **MGM Award Winners Panel Discussion**, March Meeting of the American Physical Society, Indianapolis, March 2002.
79. Judge at the **“NSF-MRSEC-APS Student Science Conference**, American Institute of Physics, College Park, May 2002.
80. **Seeing Atoms and Doing Science with the Scanned Probe Microscope**, Physics Olympiad Students, June 2002.
81. **Seeing Atoms and Doing Science with the Scanned Probe Microscope**, Physics Department, Towson State University, December 2002.