

EUGENE A. IRENE

EDUCATION

B.S. Chemistry, Manhattan College 1963

Ph.D. Solid State Chemistry, Rensselaer Polytechnic Institute 1972

EMPLOYMENT-EXPERIENCE-AWARDS

1982 - 2009 Professor of Physical Chemistry, University of North Carolina, Chapel Hill NC., Physical - Chemical, and Materials Science Aspects of Thin Film Materials for Microelectronics Applications. Electrochemical Society 1988 Callinan Award of the Dielectrics Division. Vice Chairman, Chem. Dept. 1987-1990. Visiting Professor, Ecole Centrale de Lyon, France, July 1992. Fellow of the American Vacuum Society, 1997. General Chairman of the 2nd International Conference on Spectroscopic Ellipsometry, May 1997, Visiting Professor, Univ. of Paris, Orsay, June 1998, ISI Highly Cited Researcher 2002.

1972 - 1982 IBM Thomas J. Watson Research Center Research Staff Member - Materials Science of Thin Film Electronic Materials: Chemical Vapor Deposition; Oxidation; Ellipsometry; Electron Microscopy; High Pressure Techniques; Mechanical Properties; Electrical Measurements - NASA Skylab Contribution Award 1974. IBM Technical Contribution Award 1974, 1980. International Metallographic Society Best Technical Paper Award 1979, IBM Invention Level Award 1980.

1969 - 1972 Graduate Student, Rensselaer Polytechnic Institute; R.P.I. Fellow 1970, Research Assistant 1970-1972.

1968 - 1969 Communications Officer with the Defense Communications Agency, Viet Nam, Awarded Bronze Star Medal.

1966 - 1968 Keesler AFB: Attended Communications Electronics School; Instructor; and Manager at the Electronics School.

1963 - 1966 U.S.A.F. Rocket Propulsion Laboratory: Project Scientist; Synthesis of Liquid Rocket Oxidizers; Management of Contracts Pertaining to Rocket Oxidizer Research; Junior Officer Noteworthy Accomplishment Award 1966.

1963 - 1969 U.S. Air Force Officer.

SOCIETY MEMBERSHIPS: Electrochemical Society, American Vacuum Society

(Fellow), Materials Research Society

RESEARCH ACTIVITIES

Materials Science of Thin Films and Electronics Materials

Studies of the kinetics of the oxidation of silicon, germanium, indium phosphide and gallium arsenide, and the chemical vapor deposition of thin films; high pressure silicon oxidation.

Optical properties of thin films and surfaces by ellipsometry and differential reflectance spectroscopy; in-situ real time during process measurements.

Mechanical film stress; in-situ measurements.

Morphology studies of thin films by transmission and scanning electron and optical microscopy and atomic force and scanning tunneling microscopy; Fractal analysis of surfaces.

Electrical measurements on thin films: reliability, charge storage, conductivity, capacity, interface and bulk charge, interface states, quantum oscillations and charge trapping.

Nonlinear optical effects, optical-optical switching in thin film etalon devices.

Ion beam, plasma and rapid thermal processes: film growth, etching and damage of semiconductor surfaces.

High temperature superconducting oxides; high K dielectrics

Ion scattering analysis

Solid State and High Temperature Physical Chemistry

Crystal growth of inorganic materials

Thermodynamic and kinetic studies of condensation and vaporization processes

High temperature mass spectroscopy; Hall and resistivity measurements

Defect identification (TEM, SEM, Nomarski, etch methods)

FORMER GRADUATE STUDENTS OF E.A. IRENE

M.S.

Benjamin McKee, M.S. 1985

Patricia DeLalio, M.S. 1990

Angela Shatas, M.S. 1992

Debbie Diehl, M.S. 1994

Imran Aftab, M.S. 1997

Kristine Young, M.S. 1998

Sherice Nivens, M.S. 2001

Ph.D.

1. James Buckner, Ph.D. 1987: Structural, Thermal, and Electrical Characterization of Ion Beam and Plasma Etched Monocrystalline Silicon

2. Eleanor Lewis (now Baker), Ph.D. 1987: Surface Orientation Effects on Silicon Oxidation Kinetics

3. Robert Frampton, Ph.D. 1987: Thermal Oxidation Kinetics of Metal Silicides on Silicon

4. Edward Kobeda, Ph.D. 1988: Film Stress Measurements on Thermally Oxidized Silicon

5. Susan Vitkavage (formerly Clay), Ph.D. 1988: Interfacial Electronic Characterization Studies of Silicon Surface Damage

6. Gregg Gould, Ph.D. 1988: An In-Situ Study of Silicon and Silicon Dioxide Surfaces by Contact Angle Measurement and Ellipsometry

7. John Andrews, Ph.D. 1990: Design Construction and Operation of an In-Situ Spectroscopic Ellipsometer as a Process Monitoring Instrument

8. Xuefeng Liu, Ph.D. 1991: Semiconductor Cleaning Studies: InP and Si

9. Somchai Chongsawangvirod, Ph.D. 1991: An Ellipsometric and Spectroscopic Differential Reflectance Study of the Nature of Thin SiO₂ Films and the Si-SiO₂ Interface

10. Teresa Burns (now Estrada), Ph.D. 1992: Differential Reflectance as an Analytical Tool for the Study of Microelectronic Processed Samples

11. Jordan Poler, Ph.D. 1993: Quantum Oscillations and Electron Interactions in Ultra Thin Insulating Films: A Study of the Si/SiO₂ Interface

12. Pascale Buaud, Ph.D. 1993: A Study of the Stresses in Thermally Grown Palladium and Platinum Silicide Thin Films
13. Terrence Stark, Ph.D. 1994: Electron Beam Induced Chemical Reactions at Surfaces
14. Ming Li, Ph.D. 1994: Studies of the Interaction of Ion Beams and Plasmas with Si Surface: Damage and Nucleation
15. Lycourgos Spanos, Ph.D. 1994: Studies of Silicon Surface Roughness Using Fractals, Atomic Force Microscopy and Spectroscopic Ellipsometry
16. Qian Liu, Ph.D. 1995: Optical and Morphological Studies of the Si-SiO₂ Interface
17. Jennifer Wall, Ph.D. 1995: Optical and Morphological Characterization of Polyphenylene Oxide and Related Polymers
18. Yiqiong Wang, Ph.D. 1995: Passivation Studies of Semiconductor Surfaces
19. Brian Augustine, Ph.D. 1995: Novel Silicon-Based Optical Devices and Materials
20. Kelly Hebert, Ph.D. 1996: Fowler-Nordheim Tunneling Current Oscillations: An Electronic Characterization of Ultrathin SiO₂ Films
21. Changyi Zhao, Ph.D. 1997: A Study of Si/SiO₂ Interface Roughness Evolution During Microwave Electron Cyclotron Resonance Plasma and Thermal Oxidation Processes
22. Pierre Lefebvre, Ph.D. 1997: Study of the Interfaces Produced by Thermal and Electron Cyclotron Resonance Plasma Oxidations of GaAs and Si
23. Catherine Basa, Ph.D. 1988: A Study of Nucleation of Polycrystalline Silicon on Silicon Dioxide
24. Wing Ling Liliean Lai, Ph.D. 1999: Si/SiO₂ Interface Roughness Studies
25. Ying Gao, Ph.D. 2000: Complex Oxide Interface Studies
26. Manisha Tinani, Ph.D. 2000: *In Situ* Real-Time Studies of Nickel Silicide Phase Formation
27. Alexander Heinrich Mueller, Ph.D. 2002: *In Situ* Real-Time Analysis of Complex Oxide Film Growth
28. Jason Brewer, “Plasma Nitrided SiO₂ Studies”, 2003.
29. Natalya Suvorova, “High Dielectric Constant Complex Oxides for Microelectronics”, April

2004.

30. Ciro Lopez, “A Study of HfO₂ and ZrO₂ Interfaces with Si and SiO₂”, March 2005.

31. Roshan Shrestha, “A Study of the Optical and Electronic Properties of a Semiconducting polymer, Poly(0-methoxyaniline)”, January 2006.

32. Dongxing Yang, “A Study of the Optical and Electronic Properties of Organic Thin film Transistors Based on Naphthalenetetracarboxylic Diimide Derivative”, February 2006.

FORMER POSTDOCTORALS OF E.A. IRENE

J.K. Srivastava: 1984-1986; Uean-Sin Pahk: 1987-1989; Raymond Thomas: 1987-1989

Shangting Feng: 1989-1992; Kevin Conrad: 1989-1992; Victor Yakovlev: 1991-1992

Sufi Zafar: 1993-1995; Chunlin Wang: 1994; Wentao Wu: 1997; Pavel Bulkin: 1997;

Li Yan 2004-2006

FORMER VISITING PROFESSORS

Jacques Joseph (France): 1991-1992; Sang Yeol Kim (Korea): 1993-1994

Thomas Zettler (Germany): 1992; Yao-Zhi Hu (China): April 1989-May 1996

Lee Sharpe (Grinnell College): 1995-1996; Alexander Michaelis (Germany): 1996-1997

Maria Losurdo (Italy): Feb 1996; Debora Goncalves (Brazil) 2000-2002

Yuxiang Li 2004-2006.

EUGENE A. IRENE

PUBLICATIONS

1. Ph.D. Thesis, Rensselaer Polytechnic Institute, Troy, New York 1972, "Crystal Growth and Vaporization Studies of Some Germanium Chalcogenides."
2. "Crystal Growth by Vapor Transport of GeSe, GeSe₂ and GeTe and Transport Mechanism and Morphology of GeTe," H. Wiedemeier, E.A. Irene and A.K. Chaudhuri, *J. Cryst. Growth*, 13/14, 393 (1972).
3. "The Chemical Transport Rates and Crystal Morphology of GeSe," H. Wiedemeier and E.A. Irene, *Z. Anorg. Allg. Chem.*, 400, 59 (1973).
4. "Knudsen Measurements of the Sublimation and Heat of Formation of GeSe," H. Wiedemeier and E.A. Irene, *Z. Anorg. Allg. Chem.*, 404, 299 (1974).
5. "The Sublimation Kinetics of GeSe Single Crystals," E.A. Irene and H. Wiedemeier, *Z. Anorg. Allg. Chem.*, 411, 182 (1975).
6. "Knudsen Measurements of the Sublimation and Heat of Formation of GeSe," E.A. Irene and H. Wiedemeier, *Z. Anorg. Allg. Chem.*, 424, 277 (1976).
7. "Vapor Growth of GeSe and GeTe Single Crystals in Micro-Gravity (Skylab 3 and 4 Results)," H. Wiedemeier, F.C. Klaessig, S.J. Wey and E.A. Irene, *Proc. 3rd Space Processing Symp.*, June 1974.
8. "Crystal Growth and Transport Rates of GeSe and GeTe in Microgravity Environment," H. Wiedemeier, F.C. Klaessig, E.A. Irene and S.J. Wey, *J. Cryst. Growth*, 31, 36 (1975).
9. "The Effects of Trace Amounts of Water on the Thermal Oxidation of Silicon in Oxygen," E.A. Irene, *J. Electrochem. Soc.*, 121, 1613 (1974).
10. "Some Properties of Chemically Vapor Deposited Films of Al_xO_yN_z on Silicon," E.A. Irene, V.J. Silvestri and G.R. Woolhouse, *J. Electronic Materials*, 4, 409 (1975).
11. "Chemical Vapor Deposition of Al_xO_yN_z Films," V.J. Silvestri, E.A. Irene, S. Zirinsky and J.D. Kuptsis, *J. Electronic Materials*, 4, 429 (1975).
12. "Residual Stress in Silicon Nitride Films," E.A. Irene, *J. Electronic Materials*, 5, 287 (1976).
13. "Si Oxidation Studies: Analysis of SiO₂ Film Growth Data," E.A. Irene and Y.J. Van der Meulen, *J. Electrochem. Soc.* 123, 1380 (1976).
14. "Si Oxidation Studies: The Role of H₂O," E.A. Irene and R. Ghez, *J. Electrochem. Soc.*,

124, 1757 (1977).

15. "Expansion of Thermally Grown SiO₂ Thin Films upon Irradiation with Energetic Ions," D.W. Ormond, E.A. Irene, J.E.E. Baglin and B.L. Crowder, *Ion Implantation in Semiconductors*, Ed by F. Chernow, J.A. Borders and D.K. Brice, Plenum Inc. 1976.

16. "Preparation and Some Properties of Chemically Vapor Deposited Si Rich SiO₂ and Films," D. Dong, E.A. Irene, and D.R. Young, *J. Electrochem. Soc.*, 125, (1978).

17. "Selective Studies of Chemical Vapor Deposited Aluminum Nitride Silicon Nitride Mixture Films," S. Zirinsky and E.A. Irene, *J. Electrochem. Soc.*, 125, 305 (1978).

18. "Silicon Oxidation Studies: The Oxidation of Heavily B and P Doped Single Crystal Silicon," E.A. Irene and D.W. Dong, *J. Electrochem. Soc.*, 125, 1146 (1978).

19. "Silicon Oxidation Studies: Some Aspects of the Initial Oxidation Regime," E.A. Irene, *J. Electrochem., Soc.*, 125, 1708 (1978).

20. "Some Observations of Defects in Amorphous SiO₂ Films," E.A. Irene, *Proceedings of International Topical Conference on the Physics of SiO₂ and its Interfaces*, Ed. S. Pantelides, Pergamon Inc., 1978.

21. "The Observation of Three Dimensional Defects in Amorphous Films," E.A. Irene and E. Tierney, presented at Fall 1978 meeting of *Electrochem. Soc.*, Pittsburgh, Penn., October, 1978 and Extended Abstracts.

22. "Electron Trapping in SiO₂ at 295EK and 75EK," D.R. Young, E.A. Irene, H.Z. Massoud, D.J. DiMaria and R.F. DeKeersmaecker, *J. Appl. Phys.*, 50, 6366 (1979).

23. "Tantalum Silicide Thin Films Obtained by Sputtering," J.J. Dempsey, F.M. d'Heurle, E.A. Irene and C.S. Petersson 21st Electronic Materials Conference of AIME, Boulder, Colo. June, 1979, *J. Electronic Materials*, 10, 59 (1981).

24. "Residual Stress, Chemical Etch Rate, Refractive Index and Density Measurements on SiO₂ Prepared Using High Pressure Oxygen," E.A. Irene, R.J. Zeto, and D.W. Dong, *J. Electrochem. Soc.*, 127, 396 (1980).

25. "Silicon Oxidation Studies: The Oxidation of Polycrystalline Silicon," E.A. Irene, D.W. Dong and E. Tierney, *J. Electrochem. Soc.*, 128, 705 (1980).

26. "Some Relationships between the Oxidation Mechanism and Electrical Reliability of Polycrystalline Silicon Films," E.A. Irene and E. Tierney, *Microstructural Science*, Vol. 8, 1980.

27. "On the Nature of Si Rich SiO₂ and Si₃N₄," E.A. Irene, N.J. Chou, D.W. Dong, and E.

Tierney, J. *Electrochem. Soc.* 127, 2518 (1980).

28. "An Electron Microscope Investigation of the Effect of Phosphorous Doping on the Plasma Etching of Polycrystalline Silicon," E.A. Irene, E. Tierney, J. M. Blum, C.F. Aliotta, A.C. Lamberti, and B.J. Ginsberg, *J. Electrochem. Soc.*, 128, (1981).

29. "Low Temperature - High Pressure Silicon Oxidation," E.A. Irene, 12th Semiconductor Interface Specialists Conference, December 1981.

30. "Silicon Oxidation Studies: A Model for High and Low Temperature Thermal Oxidation," Electrochemical Society Meeting, October 1981, Extended Abstract #371.

31. "Silicon Oxidation Studies: Measurement of the Diffusion of Oxidant in SiO₂ Films," E.A. Irene, *J. Electrochem. Soc.*, 129, 413 (1982).

32. "Evidence for a Parallel Path Oxidation Mechanism at the Si-SiO₂ Interface," E.A. Irene, *Appl. Phys. Letters*, 40, 74 (1982).

33. "Ellipsometry Measurements of Polycrystalline Silicon Films," E.A. Irene, and D.W. Dong, *J. Electrochem. Soc.*, 129, 1347 (1982).

34. "A Viscous Flow Model to Explain the Appearance of High Density Thermal SiO₂ at Low Oxidation Temperatures," E.A. Irene, E. Tierney, and J. Angilello, *J. Electrochem. Soc.*, 129, 2594 (1982).

35. "Oxidation of Silicide Thin Films: TiSi₂," F.M. d'Heurle, E.A. Irene, and C.Y. Ting, *Appl. Phys. Letters*, 42, 361 (1983).

36. "On the Observation Defects in Hg Cd Te Grown by Vapor Transport," E.A. Irene, E. Tierney, H. Wiedemeier, and D. Chandra, *Appl. Phys. Lett.*, 42, 710 (1983).

37. "Silicon Oxidation Studies: A Revised Model for Thermal Oxidation," E.A. Irene, *J. Appl. Phys.* 54, 5416 (1983).

38. "Silicon Oxidation: The Status and New Directions," E.A. Irene, *Semiconductor International*, April 1983 p. 99.

39. "An Overview of the Kinetics of Oxidation of Silicon: The Very Thin SiO₂ Film Growth Regime," E.A. Irene, *Passivity of Metals and Semiconductors*, Ed. M. Froment, Elsevier (1983).

40. "Silicon Dioxide Films in Semiconductor Devices," J.M. Aitken, and E.A. Irene, *Treatise on Materials Science and Technology, Glass IV, Vol. 26*, Ed. M. Tomozawa, R.H. Doremus, Academic Press 1985, p. 1.

41. "Thermally Prepared SiO₂ Film for VLSI," E.A. Irene, *Semiconductor International*, June 1985, p. 92.
42. "Silicon Oxidation: A Process Step for the Manufacture of Integrated Circuits," E.A. Irene, *American Chemical Society Symposium 290, Chemical and Physical Processes of Integrated Circuits*, Ed. P. Stroeve, Oct. 1985, p. 31.
43. "Thermal Oxidation of Silicon in Dry Oxygen: Accurate Determination of the Kinetic Constants," H.Z. Massoud, J.D. Plummer and E.A. Irene, *J. Electrochem. Soc.*, 132, 1745 (1985).
44. "Thermal Oxidation of Silicon in Dry Oxygen: Growth Rate Enhancement in the Thin Regime. I. Experimental Results," H.Z. Massoud, J.D. Plummer, and E.A. Irene, *J. Electrochem. Soc.*, 132, 2685 (1985).
45. "Thermal Oxidation of Silicon in Dry Oxygen Growth Rate Enhancement in the Thin Film Regime. II Physical Mechanism," H.Z. Massoud, J.D. Plummer, and E.A. Irene, *J. Electrochem. Soc.*, 132, 2693 (1985).
46. "A Measurement of the Effect of Intrinsic Film Stress on the Overall Rate of Thermal Oxidation of Silicon," J.K. Srivastava and E.A. Irene, *J. Electrochem. Soc.*, 132, 2815 (1985).
47. "The Rate of Formation of Silicon Dioxide; Semiconducting Ruthenium Silicide," F.M. d'Heurle, R.D. Frampton, E.A. Irene, H. Jiang and C.S. Petersson, *Appl. Phys. Lett.*, 47, 1170 (1985).
48. "Models for the Oxidation of Silicon," E.A. Lewis and E.A. Irene, *J. Vac. Sci. and Tech., J. Vac. Sci. Technol. A*, 4, 916 (1986).
49. "Optical Model for the Ellipsometric Characterization of Low Energy Ion-Beam Damage in Single Crystal Silicon," J.L. Buckner, D.J. Vitkavage, E.A. Irene and T.M. Mayer, *J. Electrochem. Soc.*, 133, 1729 (1986).
50. "Silicon Orientation Effects on Thermal Oxidation of Silicon," E.A. Irene, H.Z. Massoud and E. Tierney, *J. Electrochem. Soc.*, 133, 1253 (1986).
51. "On the Measurement of Effective Complex Refractive Indices for Selected Metal Silicides," R.D. Frampton, E.A. Irene and F.M. d'Heurle, *J. Appl. Phys.*, 59, 978 (1986).
52. "A Measurement of Intrinsic SiO₂ Film Stress Resulting from Low Temperature Thermal Oxidation of Si," E. Kobeda and E.A. Irene, *J. Vac. Sci. Technol. B*, 4, 720 (1986).
53. "Low Temperature Silicon Oxidation Studies," E.A. Lewis, E. Kobeda and E.A. Irene, *Semiconductor Silicon 1986*, Ed. H.R. Huff, T. Abe and B. Kolbesen, p. 416.

54. "New Results on Low Temperature Oxidation of Silicon," E.A. Irene, *Phil. Mag. B*, **55**, 131 (1987).
55. "Intrinsic SiO₂ Film Stress Measurements on Thermally Oxidized Si," E. Kobeda and E.A. Irene, *J. Vac. Sci. Technol. B*, **5**, 15 (1987).
56. "Low Temperature Growth of Silicon Dioxide Films: A Study of Chemical Bonding by Ellipsometry and Infrared Spectroscopy," G. Lucovsky, M.J. Mantini, J.K. Srivastava and E.A. Irene, *J. Vac. Sci. Technol. B*, **5**, 530 (1987).
57. "Two Step Oxidation Processes in Silicon," N.M. Ravindra, D. Fathy, J. Narayan, J.K. Srivastava and E.A. Irene, *Mat. Lett.*, **4**, 337 (1986).
58. "Silicon Oxidation and Si-SiO₂ Interface of Thin Oxides," N.M. Ravindra, J. Narayan, D. Fathy, J.K. Srivastava and E.A. Irene, *J. Mat. Research*, Vol. 6 Nov./Dec. (1986).
59. "The Influence of Silicon Surface Cleaning Procedures on Silicon Oxidation," G. Gould and E.A. Irene, *J. Electrochem. Soc.*, **134**, 1031 (1987).
60. "The Effect of Surface Orientation on Silicon Oxidation Kinetics," E.A. Lewis and E.A. Irene, *J. Electrochem. Soc.*, **134**, 2332 (1987).
61. "Anomalous Oxidation Rate of Silicon Implanted with Very High Doses of Arsenic," S.S. Choi, M.Z. Numan, E.A. Irene and W.K. Chu, *Appl. Phys. Lett.*, **51**, 1001 (1987).
62. "Redistribution of Arsenic in Silicon during High Pressure Thermal Oxidation," S.S. Choi, M.Z. Numan, W.K. Chu, J.K. Srivastava, and E.A. Irene, *Appl. Phys. Lett.*, **50**, 688 (1987).
63. "Thermionic Emission Model for the Initial Stage of Silicon Oxidation," E.A. Irene and E.A. Lewis, *Appl. Phys. Lett.*, **51**, 767 (1987).
64. "Thermal Oxidation of Silicides on Silicon," F.M. d'Heurle, A. Cros, R.D. Frampton and E.A. Irene, *Phil. Mag. B*, **55**, 291 (1987).
65. "A Study of the Oxidation of Selected Metal Silicides," R.D. Frampton, E.A. Irene and F.M. d'Heurle, *J. Appl. Phys.*, **62**, 2972 (1987).
66. "Thermal Oxidation of Silicon: New Experimental Results and Models," E.A. Irene and R. Ghez, presented at INFOS 87 Leuven, Belgium, April 13, 1987, and *Appl. Surface Science*, **30**, 1 (1987).
67. "Models for the Oxidation of Silicon," E.A. Irene, *CRC Critical Reviews in Solid State and Materials Science*, Ed. J.E. Greene, Vol 14(2), pp 175-223 (1988).
68. "Ellipsometric and Rutherford Backscattering Characterization of Low Energy

Hydrogen, Helium, Neon and Argon-Bombarded Silicon," J.L. Buckner, D.J. Vitkavage and E.A. Irene, *J. Appl. Phys.*, **63**, 5288 (1988).

69."Electrical and Ellipsometric Characterization of the Removal of Silicon Surface Damage Resulting from Ion Beam and Plasma Processing," S.C. Vitkavage and E.A. Irene, *J. Appl. Phys.*, **64**,1983 (1988).

70."SiO₂ Film Stress Distribution during Thermal Oxidation of Silicon," E. Kobeda and E.A. Irene, *J. Vac. Sci. Technol. B*, **6**, 574 (1988).

71."An In-Situ Study of Aqueous HF Treatment of Silicon by Contact Angle Measurement and Ellipsometry," G. Gould and E.A. Irene, *J. Electrochem. Soc.*, **135**, 1535 (1988).

72."Thermal Oxide Growth on Silicon: Intrinsic Stress and Silicon Cleaning Effects," in *Deposition and Growth: Limits for Microelectronics*, AVS Series #4 AIP Conference Proceedings 167, Ed. G. Rubloff, 1988).

73."Silicon Oxidation Studies: A Review of Recent Studies on Thin Film Silicon Dioxide Formation," E.A. Irene, "The Physics and Chemistry of SiO₂ and the Si-SiO₂ Interface," Ed C.R. Helms and B.E. Deal, Plenum, New York, 61 (1988).

74."An In-Situ Ellipsometric Study of Aqueous NH₄OH Treatment of Silicon", G. Gould and E.A. Irene, *J. Electrochem. Soc.*, **136**, 1108 (1989).

75."A Derivative Method For Interface State Density Determination at the Silicon-Silicon Dioxide Interface", S.C. Vitkavage and E.A. Irene, *J. Appl. Phys.*, **64**, 6581 (1988).

76."Molecular Sieving by Electropolymerized Porphyrin Films Only a few Monolayers Thick, K.A. Pressprich, S.G. Maybury, R.E. Thomas, R.W. Linton, E.A. Irene, and R.W. Murray, *J. Phys. Chem.*, **93**, 5568 (1989).

77."Local Atomic Structure of Thermally Grown SiO₂ Films, G. Lučovský, J.T. Fitch, E. Kobeda and E.A. Irene, "The Physics and Chemistry of SiO₂ and the Si-SiO₂ Interface," Ed C.R. Helms and B.E. Deal, Plenum, New York, 139 (1988).

78."Effects of Thermal History on Stress-Related Properties of Very Thin Films of Thermally Grown Silicon Dioxide, SiO₂", J.T. Fitch, E. Kobeda, G. Lučovský and E.A. Irene, *J. Vac. Sci. Technol. B*, **7**, 153 (1989).

79."Measurements and Modelling of Thin Silicon Dioxide Films on Silicon", A. Kalnitsky, S.P.Tay, J.P. Ellul, S. Chongsawangvirod, J.W. Andrews, and E.A. Irene, *J. Electrochem. Soc.*, **137**, 234, (1990).

80."In-Situ Stress Measurements During Thermal Oxidation of Silicon", E. Kobeda and E.A. Irene, *J. Vac. Sci. and Technol. B*, **7**, 163 (1989).

81. Review of Conduction in Non-Crystalline Materials, by N.F. Mott, J. Am. Chem. Soc., **110**, 6600 (1988).
82. "Ellipsometric, Microscopic, and Electrochemical Studies of the Electrochemical Polymerization of an Osmium Vinylpyridine Complex", R.L. McCarley, R.E. Thomas, E.A. Irene, and R.W. Murray, J. Electrochem. Soc., **131**, 1485(1990).
83. "In-Situ Spectroscopic Ellipsometry Investigation of Ion Beam Damage: A Kinetic Study", J.W. Andrews, Y.Z. Hu and E.A. Irene, SPIE 1989 (Oct.) Symposium on Microelectronic Integrated Processing: Growth Monitoring and Control, Proceedings Jan. 1990.
84. "An Ellipsometric Measurement of the Optical Properties for InP Surfaces", X. Liu E.A. Irene, S. Hattangady and G. Fountain, J. Electrochem. Soc., **137**, 2319(1990).
85. "In Situ Differential Reflectance Study of the Etching of SiO₂ Films", U.S. Pahk, S. Chongsawangvirod and E.A. Irene, J. Electrochem. Soc., **138**, 308(1991).
86. "Optical, Electrical, and Electrochemical Characteristics of Ultrathin Poly(Phenylene Oxide) Films: Organic Dielectrics Less Than 10 nm Thick", R.L. McCarley, R.E. Thomas, E.A. Irene and R.W. Murray, J. Electroanal. Chem., **290**, 79(1990).
87. "Observations of Nonlinear Reflectivity From InSb Surfaces and Optical Switching Applications", S. Feng, R.E. Thomas, R.C. Jarnagin and E.A. Irene, SPIE Conference, OE LASE '90 Proceedings, Jan 1990.
88. "Refractive Index Profiles of Thermally Grown and Chemically Deposited Films on Silicon", S. Chongsawangvirod, E.A. Irene, A. Kalnitsky, S.P. Tay, and J.P. Ellul, Sixth Int'l Symposium on Silicon Materials Science and Technology, May 1990, Proceedings and J. Electrochem. Soc., **137**, 3536(1990).
89. "Annealing Characteristics of Ultrathin Gate Oxides Grown at Low Temperatures", S.P. Tay, A. Kalnitsky, G. Kelly, J.P. Ellul, P. DeLalio and E.A. Irene, J. Electrochem. Soc., **137**, 3579(1990).
90. "An Investigation of Si-SiO₂ Interface Charges in Thermally Oxidized (100), (110), (111), and (511) Silicon", S.C. Vitkavage, E.A. Irene and H.Z. Massoud, J. Appl. Phys., **68**, 5262(1990).
91. "Permeant Molecular Sieving with Electrochemically Prepared 6 nm Films of Poly-Phenylene Oxide", R.L. McCarley, E.A. Irene, and R.W. Murray, J. Phys. Chem., **95**, 2492(1991).

92. "A Comparison of the Measurement of Ion Damage in Silicon Surfaces Using Differential Reflectance and Spectroscopic Ellipsometry", T.M. Burns, S. Chongsawangvirod, J.W. Andrews, E.A. Irene, G. McGuire and S. Chevacharoeukul, *J. Vac. Sci. and Technol. B*, **9**, 41(1990).
93. "Damage Mechanisms from Ion Beams and Plasmas: In-Situ Ellipsometric Experiments and Models", J.W. Andrews, Y.Z. Hu, M. Li and E.A. Irene, Proceedings of "Second International Symposium on Process Physics and Modeling in Semiconductor Technology", Montreal Canada, May 6-11, 1990.
94. "Ex-Situ and In-Situ Ellipsometric Studies of the Thermal Oxide on InP", X. Liu, J.W. Andrews and E.A. Irene, *J. Electrochem. Soc.*, **138**, 1106(1991).
95. "A Spectroscopic Differential Reflectometry Study of (100), (110), (111), (311) and (511) Silicon Surfaces", S. Chongsawangvirod and E.A. Irene, *J. Electrochem. Soc.*, **138**, 1748(1991).
96. "Studies Hydrogen Ion Beam Cleaning of Silicon Dioxide From Si Using In-Situ Spectroscopic Ellipsometry and X-ray Photoelectron Spectroscopy", Y.Z. Hu, K.A. Conrad, M. Li, J. Andrews, J. Simko, and E.A. Irene, *Appl. Phys. Lett.*, **58**, 589(1991).
97. "Spectral Dependence of External Reflection Switching from Indium Antimonide", S. Feng and E.A. Irene, *Appl. Phys. Lett.*, **58**, 455(1991).
98. "Optical Switching and Optical Logic in a Thermally Expanding Si Etalon", S.T. Feng and E.A. Irene, *Appl. Phys. Lett.*, **58**, 2073(1991).
99. "In-Situ Strain Measurements During the Formation of Platinum Silicide Films", P.P. Baud, F.M. d'Heurle, E.A. Irene, B.K. Patnaik and N.R. Parikh, *J. Vac. Sci. Technol. B*, **9**, Sept/Oct., 2536(1991).
100. "An In-Situ Spectroscopic Ellipsometry Study of the Electron Cyclotron Resonance Plasma Oxidation of Silicon and Interfacial Damage", Y.Z. Hu, J. Joseph and E.A. Irene, *Appl. Phys. Lett.*, **59**, 1353(1991).
101. "In-Situ Ellipsometry For Temperature Measurement in Rapid Thermal Processing", H.Z. Massoud, R.K. Sampson, K.A. Conrad, Y.-Z. Hu and E.A. Irene, Proceedings of the Third International Symposium on Ultra Large Scale Integration Science and Technology 1991, J.M. Andrews and G.C. Celler, Editors, PV 91-11, p 541, The Electrochemical Society Proceedings Series, Pennington, N.J. (1991).
102. "A Comparison of Argon and Hydrogen Ion Etching and Damage in the Si-SiO₂ System", Y.Z. Hu, M. Li, J.W. Andrews, K.A. Conrad and E.A. Irene, *J. Electrochem. Soc.*, **139**, 2022(1992).

103. "Study of Nonlinear Reflection and Optical Switching in Indium Antimonide", S.T. Feng and E.A. Irene, *J. Appl. Phys.*, **71(5)**, 2123(1992).
104. "An Oxygen Tracer Study of InP Oxidation", X. Liu, M.S. Denker and E.A. Irene, *J. Electrochem. Soc.*, **139**, 799(1992).
105. "In-Situ Spectroscopic Ellipsometry Studies of Hydrogen Ion Bombardment of Crystalline Silicon", Y.Z. Hu, M. Li, K. Conrad, J.W. Andrews, E.A. Irene, M. Denker, M. Ray and G. McGuire, *J. Vac. Sci. Technol. B*, **10(3)**, 1111 (1992).
106. "In situ spectroscopic ellipsometric investigation of argon ion bombardment of single-crystal silicon and silicon dioxide films", Y.Z. Hu, J.W. Andrews, M.Li and E.A. Irene, *Nuc. Instrum. and Methods Phys. Res*, **B59/60**, 76(1991).
107. "A Kinetics study of the Electron Cyclotron Resonance Plasma Oxidation of Silicon", J. Joseph, Y.Z. Hu, and E.A. Irene, *J. Vac. Sci. and Tech. B*, **10**, 611(1992).
108. "An Interface Enhanced Spectroscopic Ellipsometry Technique: Application To Si-SiO₂", V.A. Yakovlev and E.A. Irene, *J. Electrochem. Soc.*, **139**, 1450 (1992).
109. "Infrared Rotating Analyzer Ellipsometry: Calibration and Data Processing", V.A. Yakovlev, M. Li and E.A. Irene, *J. Opt. Soc. Am.*, **10(3)**, 509 (1993).
110. "Langmuir Probe and Optical Emission Studies of Ar, O₂ and N₂ Plasmas Produced by an ECR Microwave Source", A.A. Shatas, Y.Z. Hu and E.A. Irene, *J. Vac. Sci. and Tech. A*, **10**, 3119 (1992).
111. "A Spectroscopic Immersion Ellipsometry Study of the Mechanisms of Si/SiO₂ Interface Annealing", V.A. Yakovlev, Q. Liu and E.A. Irene, *J. Vac. Sci. and Tech. B*, **10**, 427 (1992).
112. "In-Situ Atomic Force Microscopic Imaging of Electrochemical Formation of a Thin Dielectric Film..POLY(PHENYLENE OXIDE)", C.A. Goss, J.C. Brumfield, E.A. Irene, R.W. Murray, *Langmuir.*, **8**, 1459 (1992).
113. "Thermo-Optical Switching in Si based Etalons", S.T Feng and E.A. Irene, *J. Appl. Phys.*, **72**, 3897 (1992).
114. "Spectroscopic Ellipsometric Measurements of Visible-UV Dielectric Function of GeO₂ Films on Crystal Germanium, Y.Z. Hu, J.-Th. Zettler, S. Chongsawangvirod, Y.Q. Wang and E.A. Irene, *Appl. Phys. Lett.*, **61(9)**, 1098 (1992).
114. "Kinetics of Oxidation of Silicon by Electron Cyclotron Resonance Plasmas", J.

Joseph, Y.Z. Hu and E.A. Irene, "The Physics and Chemistry of SiO₂ and the Si-SiO₂ Interface," Ed C.R. Helms and B.E. Deal, Plenum, New York, (1993).

116. "A New Ellipsometry Technique for Interface Analysis: Application to Si-SiO₂", E.A. Irene and V.A. Yakovlev, "The Physics and Chemistry of SiO₂ and the Si-SiO₂ Interface," Ed C.R. Helms and B.E. Deal, Plenum, New York, (1993).

117. "Spectroscopic Differential Reflectance as an Analytical Probe for Microelectronics Processing", T.M. Burns, E.A. Irene, G. McGuire and S. Chevacharoeukul, J. Vac. Sci. and Technol. B, 11(1), 78 (1993).

118. " Pre-Oxidation Anneal Kinetics: Interface Degradation of Thin SiO₂ Films on Silicon", J.C. Poler and E.A. Irene, Proceedings of 1992 MRS Symposium on Chemical Surface Preparation, Eds. Rubloff, and Nemanich 1992.

119. "Hillock Formation in Platinum Films", P.D. Hren, H. Al-Shareef, S.H. Rou, A.I. Kingon, P. Buaud and E.A. Irene, Proceedings of 1992 MRS Symposium C Vol 260.

120. "Preparation and Characterization of Laterally Heterogenous Polymer Modified Electrodes Using In-Situ Atomic Force Microscopy", J.C. Brumfield, C.A. Goss, E.A. Irene and R.W. Murray, Langmuir, 8, 2810 (1992).

121. "Novel Charge Integrating Pulsed I(V) Technique: A Measurement of Fowler-Nordheim Currents Through Thin SiO₂ Films", J.C. Poler, W.S. Woodward and E.A. Irene, *Rev. Sci. Instrum.*, **64**, 781 (1993).
122. "Pump-Probe Charge Integrating Technique: A Study of Trap Emission Kinetics in Silicon Dioxide", J. Poler and E.A. Irene, *Appl. Phys. Lett.*, **62**, 3123 (1993).
123. "Ellipsometric Monitoring and Control of the Rapid Thermal Oxidation of Silicon", K.A. Conrad, R.K. Sampson, H.Z. Massoud and E.A. Irene, *J. Vac. Sci. and Technol. B*, **11**, 2096 (1993).
124. "Simultaneous Silicon Wafer Temperature and Oxide Film Thickness Measurement in RTP Using Ellipsometry", R.K. Sampson, K.A. Conrad, E.A. Irene and H.Z. Massoud, *J. Electrochem. Soc.*, **140**, 1734 (1993).
125. "Imaging The Incipient Electrochemical Oxidation of Highly Oriented Pyrolytic Graphite", C.A. Goss, J.C. Brumfield, E.A. Irene and R.W. Murray, *Anal. Chem.*, **65**, 1378 (1993).
126. "Applications of In-Situ Ellipsometry to Microwave Electron Cyclotron Resonance Plasma Processes", Y.Z. Hu, J. Joseph and E.A. Irene, *J. Vac. Sci. Technol. A*, **11(4)**, 1786 (1993).
127. "In-situ strain measurements during the formation of palladium silicide films", P.P. Buaud, F.M. d'Heurle, S. Chevacharoenkul and E.A. Irene, *J. Vac. Sci. Technol. B* **11(2)**, 304 (1993).
128. "Characterization of the Si-SiO₂ Interface Morphology from Quantum Oscillations in Fowler-Nordheim Tunneling Currents", J.C. Poler, K.K. McKay and E.A. Irene, *J. Vac. Sci. Technol. B*, **12(1)**, 88 (1994).
129. "Investigation of Trap Emission Kinetics in MOS Capacitors Using a Pump-Probe Charge Integrating Technique", J.C. Poler and E.A. Irene, *J. Appl. Phys.*, **75**, 2555 (1994).
130. "Applications of Spectroscopic Ellipsometry to Microelectronics", E.A. Irene, presented at First International Conference on Spectroscopic Ellipsometry, Paris, France, Jan. 11-14, 1993 and *Thin Solid Films*, **233**, 96 (1993).
131. "An Ellipsometry Investigation of Nucleation and Growth of Electron Cyclotron Resonance Plasma Deposited Silicon Films", M. Li, Y.Z. Hu, J. Wall, K. Conrad and E.A. Irene, *J. Vac. Sci. Technol. A*, **11(4)**, 1686 (1993).
132. "In-Situ Investigation of Temperature and Bias Dependent Effects on the Oxide Growth of Si and Ge in and ECR Plasma, Y.Z. Hu, Y. Wang, M. Li and E.A. Irene, *J. Vac. Sci. Technol. A*, **11(4)**, 900 (1993).

133. "Effects of Oxygen Doping on Properties of Microcrystalline Silicon Films Using Rapid Thermal Chemical Vapor Deposition", X.-L. Xu, V. Misra, M.C. Ozturk, J.J. Wortman, G.S. Harris, D.M. Maher, L. Spanos and E.A. Irene, *J. Electron. Mats.*, 22, 1345 (1993).
134. "Ellipsometry studies of semiconductor surface cleaning", E.A. Irene and Y.Z. Hu, Materials Research Society, Proceedings of Symposium Y: Surface Chemical Cleaning and Passivation for Semiconductor Processing, (1993).
135. "Si/SiO₂ Interface studies by immersion ellipsometry", Q. Liu and E.A. Irene, Materials Research Society, Proceedings of Symposium Y: Surface Chemical Cleaning and Passivation for Semiconductor Processing, (1993).
136. "A Fractal Study of Silicon Surfaces", L. Spanos and E.A. Irene, Materials Research Society, Proceedings of Symposium Y: Surface Chemical Cleaning and Passivation for Semiconductor Processing, (1993).
137. "Thickness Measurements and Optical Characterization of Thin Polymer Films", J.F. Wall, J.C. Brumfield, R.W. Murray and E.A. Irene, Materials Research Society, Proceedings of Symposium H: Polymer/Inorganic Interfaces, (1993).
138. "Thermal-Optical Switching of a Silicon Based Interference Filter", B.H. Augustine, S.T. Feng, M.A. Ray and E.A. Irene, *J. Appl. Phys.*, 75(4), 1875 (1994).
139. "Spectroscopic Ellipsometry and Atomic Force Microscopy of Polyphenylene Oxide Films", J.F. Wall, J.C. Brumfield, R.W. Murray and E.A. Irene, *J. Electrochem. Soc.*, 141, 306 (1994).
140. "Electron Cyclotron Resonance Plasma Process for InP Passivation", Y.Z. Hu, M. Li, Y. Wang, E.A. Irene, M. Rowe and H.C. Casey Jr., *Applied Physics Lett.*, 63, 1113 (1993).
141. "Electron Cyclotron Resonance Plasma Oxidation Studies of InP", Y.Z. Hu, J. Joseph and E.A. Irene, *J. Vac. Sci. Technol. B*, 12(2) 540 (1994).
142. "Wavelength Considerations for Improved Silicon Wafer Temperature Measurements by Ellipsometry", R.K. Sampson, K.A. Conrad, H.Z. Massoud and E.A. Irene, *J. Electrochem. Soc.*, 141, 539 (1994).
143. "Si/SiO₂ Interface Studies by Spectroscopic Immersion Ellipsometry and Atomic Force Microscopy", Q. Liu, J. Wall and E.A. Irene, *J. Vac. Sci. Technol. A*, 12, 2625 (1994).
144. "In-Situ Investigation of Silicon surface Cleaning and Damage by Argon Electron Cyclotron Resonance Plasmas", Y.Z. Hu, P. Buaud, Y. Wang, M. Li and E.A. Irene, *Appl. Phys. Lett.* 64, 1233 (1994).

145. "Characterization of Oxygen-Doped and Non-Oxygen-Doped Polysilicon Films Prepared by Rapid Thermal Chemical Vapor Deposition, X.-L. Xu, V. Misra, G.S. Harris, L. Spanos, M.C. Ozturk, J.J. Wortman, D.M. Maher, and E.A. Irene, *Materials Res. Soc. Symp. Proc.*, **303**, 49 (1993).
146. "An Ellipsometric Determination of the Thickness and Refractive Index of Silicon Films", M. Li, V.A. Yakovlev, J. Wall and E.A. Irene, *J. Vac. Sci. Technol.B*, **11**, 2102, (1993).
147. "Electron Cyclotron Resonance Plasma and Thermal Oxidation Mechanisms of Germanium ", Y. Wang, Y.Z. Hu and E.A. Irene, *J. Vac. Sci. Technol.A*, **12**, 1309 (1994).
148. "Ellipsometry Study of the Nucleation of Si Epitaxy by Electron Cyclotron Resonance Plasma Chemical Vapor Deposition", M. Li, Y.Z. Hu, E.A. Irene and L. Liu, K.N. Christensen, and D. Maher, *J. Vac. Sci. Technol B*, **13(1)**, 105 (1995).
149. "In-Situ Electron Cyclotron Resonance Plasma Surface Cleaning of Silicon", Y.Z. Hu, P.P. Buaud, L. Spanos, Y. Wang, M. Li and E.A. Irene, *J. Vac. Sci. Technol A*, **12**, 1315 (1994).
150. "Post Calibration Correction for Rotating Analyzer Ellipsometer with Optical Fiber Bundle Detection System", S.Y. Kim, L.S. Spanos and E.A. Irene, *J. Korean Phys. Soc.*, **28**, 420 (1995).
151. "Investigation of Roughened Silicon Surfaces Using Fractal Analysis, Part I: 2D Variation Method", L. Spanos and E.A. Irene, *J. Vac. Sci. Technol. A*, **12(5)**, 2646 (1994).
152. "Investigation of Roughened Silicon Surfaces Using Fractal Analysis, PartII: Chemical Etching, Rapid Thermal Chemical Vapor Deposition and Thermal Oxidation", L. Spanos, Q. Liu, T. Zettler, B. Hornung, J.J. Wortman and E.A. Irene, *J. Vac. Sci. Technol. A*, **12(5)**, 2653, (1994).
153. "Comparison of Damage and Si Oxidation Kinetics Resulting from Electron Cyclotron Resonance and Distributed Electron Cyclotron Resonance Plasma Processing", Y.Z. Hu, M. Li, Y. Wang, E.A. Irene, M.C. Hugon, F. Varniere, N. Jiang, M. Froment and B. Agius, *J. Vac. Sci. Technol B*, **13(2)**, 227 (1995).
154. "Tunneling Current in Thin Silicon Dioxide Films", S. Zafar, J.C. Poler, E.A. Irene, X. Xu, G. Hames, R. Kuehn and J.J. Wortman, presented at Spring 1994 MRS Conference in San Francisco CA and accepted for publication in MRS Proceedings for Rapid Thermal Processing Symposium.
155. "A Study of Tunneling Current Oscillation Dependence on SiO₂ Thickness and Si

Roughness at the Si/SiO₂ Interface", S. Zafar, Q. Liu and E.A. Irene, J. Vac. Sci. Technol. A, 13(1), 47 (1995).

156. "A Comparison of the Oxidation and Passivation of Si, Ge and InP" E.A. Irene, Presented (Invited) at the 7th International Symposium on the Passivity of Metals and Semiconductors, Clausthal, Germany August 21-26 1994 and Materials Science Forum, 185-188, 37 (1995).

157. "A Morphology Study of the Thermal Oxidation of Rough Silicon Surfaces", Q. Liu, L. Spanos, C. Zhao and E.A. Irene, J. Vac. Sci. Technol. A, 13, 1977 (1995).

158. "An In-Situ Real Time Measurement of the Incubation Time for Si Nucleation on SiO₂ in a Rapid Thermal Process" Y.Z. Hu, D.J. Diehl, Q. Liu, C.Y. Zhao and E.A. Irene, Appl. Phys. Lett., 66, 700 (1995).

159. "Thickness and Effective Electron Mass Measurements for Thin Silicon Dioxide Films Using Oscillations in the Tunneling Current", S. Zafar, K.C. Conrad, Q. Liu, E.A. Irene and G.Hames, R. Kuehn and J.J. Wortman, Applied Physics Lett., 67, 1031 (1995).

160. "A Study of Silicon Epitaxial Growth on Silicon Substrates Exposed to Ar Electron Cyclotron Resonance Plasmas" P.P. Buaud, Y.Z. Hu, L. Spanos. K.N. Christensen, D. Venables and D.M. Maher, J. Vac. Sci. Technol. B, 13, 1442 (1995).

161. "Real Time Monitoring of the Deposition and Growth of Thin Organic Films by In-Situ Ellipsometry", J. Wall, E. Clauberg, R.W. Murray and E.A. Irene, J. Vac. Sci. Technol. A, 13, 2348 (1995).

162. "Incipient Electrochemical Oxidation of Highly Oriented Pyrolytic Graphite: Correlation Between Surface Blistering and Electrolyte Anion Intercalation", K.W. Hathcock, J.C. Brumfield, C.A. Goss, E.A. Irene and R.W. Murray, Anal. Chem., 67, 2201 (1995).

163. "Visible Light Emission from Thin Films Containing Si, O, N and H", B.H. Augustine, E.A. Irene, Y.J. He, K.J. Price, L.E. McNeill, K.N. Christensen and D.M. Maher, J. Appl. Phys., 78(6), 4020 (1995).

164. "A Measurement of N in Nitrided Oxides Using Spectroscopic Immersion Ellipsometry" E.A. Irene, Q. Liu, W.M. Paulson, P.J. Tobin and R.I. Hegde, J. Vac. Sci. Technol. B, 14(3), 1697 (1996).

165. "Real Time Investigation of Nucleation and Growth of Silicon on Silicon Dioxide Using Silane and Disilane in a Rapid Thermal Processing System", Y.Z. Hu, D.J. Diehl, C.Y. Zhao, C.L. Wang, Q. Liu, and E.A. Irene, J. Vac. Sci. Technol. B, 14(2), 744 (1996).

166. "An Annealing Study of Luminescent Amorphous Silicon-Rich Silicon Oxynitride Thin Films", B.H. Augustine, Y.Z. Hu, E.A. Irene and L.E. McNeil, Appl. Phys. Lett., 67, 3694

(1995).

167. "In-Situ Investigation of the Passivation of Si and Ge by Electron Cyclotron Resonance Plasma Enhanced Chemical Vapor Deposition of SiO₂" by Y. Wang, Y.Z. Hu and E.A. Irene, *J. Vac. Sci. Technol. B*, **14**, 1687 (1996).

168. "In-Situ Ellipsometry in Microelectronics", E.A. Irene and J.A. Woollam, *Materials Res. Soc. Bull.*, Vol XX, 24 (1995).

169. "A Measurement of the Refractive Index of Thin SiO₂ Films Using Tunneling Current Oscillations and Ellipsometry", by K.J. Hebert, S. Zafar, E.A. Irene, R Kuehn, T.E. McCarthy and E.K. Demirlioglu., *Appl. Phys. Lett.*, **68**, 266 (1996).

170. "An Evaluation of Errors in Determining Refractive Index and Thickness for Thin SiO₂ Films Using a Rotating Analyzer Ellipsometer", S.Y. Kim and E.A. Irene, *Rev. of Scientific Inst.*, **66**, 5277 (1995).

171. "Thermal and Electron Cyclotron Resonance Plasma Oxidation Studies of Gallium Arsenide", P.R. Lefebvre and E.A. Irene, *Proceedings of the "State-of-the-Art Program on Compound Semiconductors XXIV"* Eds F. Ren, S.J. Pearton and W. Pletschen, Los Angeles CA, May 1996.

172. "A Measurement of the Refractive Index for Ultra Thin SiO₂ films and a Reevaluation of the Thermal Si Oxidation Kinetics in the Thin Film Regime", K.J. Hebert, T. Labayen and E.A. Irene, *Physics and Chemistry of SiO₂ and the Si-SiO₂ Interface III*, eds H.Z. Massoud, C.R. Helms and E.H. Poindexter, p 81 (1996).

173. "Effects of Hydrogen Ion Beam Silicon Dioxide Surface Pretreatment on the Nucleation and Surface Roughness of Polycrystalline Silicon Films Prepared by Rapid Thermal Chemical Vapor Deposition", Y.Z. Hu, C.Y. Zhao, C. Basa, W.X.Gao, and E.A. Irene, *Appl. Phys. Lett.*, **69**, 485 (1996).

174. "Characterizations of Metallic and Organic Contamination on Si Surfaces and the Influence of the Contaminants on Gate Oxide Quality", X. Liu, R. Graham and E.A. Irene, *J. Electrochem. Soc.* submitted October 1996.

175. "Studies of Film Growth Processes and Surface Structural Characterization of Ferroelectric Memory Compatible SrBi₂Ta₂O₉ Layered Perovskites Via In-Situ, Real Time Ion Beam Analysis", O. Auciello, A.R. Krauss, J.Im, D.M. Gruen, E.A. Irene, R.P.H. Chang and G.E. McGuire, *Appl. Phys. Lett.* **69**, 2671 (1996).

176. Review of "Surface Phases on Silicon: Preparation, Structure and Properties, by V.G. Lifshits, A.A. Saranin and A.V. Zotov, Wiley, Chichester. 1995 in *J. Am, Chem. Soc.*, **118**, 9207 (1996).

177. A Characterization of the luminescence center in photo- and electroluminescent amorphous silicon oxynitride films, K.J. Price, L.E. McNeil, E.A. Irene, A. Suvkanov, P.J. MacFarlane and M.E. Zvanut, *J. Appl. Phys.*, **86**, 2628 (1999).
178. "A study of oxygen diffusion in and out of $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ thin films" A. Michaelis, E. A. Irene, O. Auciello and A. R. Krauss, *Journal of Applied Physics*, **83**(12), 7736 (1998).
179. "Fowler-Nordheim Tunneling Current Oscillations at Metal/Oxide/Si Interfaces", K.J. Hebert and E.A. Irene, *J. Appl. Phys.*, **82**, 291 (1997).
180. "Comparison of Si and GaAs Interfaces Resulting from Thermal and Plasma Oxidation, P.R. Lefebvre and E.A. Irene, *J. Vac. Sci. Technol. B*, **15**, 1173 (1997).
181. "Characterization of Ultrathin SiO_2 Films Grown by Rapid Thermal Oxidation", Y.Z. Hu, S.P. Tay, Y. Wasserman, C.Y. Zhao, K.J. Hebert and E.A. Irene, *J. Vac. Sci. Technol. A*, **15**, 1394 (1997).
182. "Comparison of the Physical and Electrical Properties of Electron Cyclotron Resonance and Distributed Electron Cyclotron Resonance SiO_2 , M. Firon, M.C. Hugon, B. Agius, Y.Z. Hu, Y. Wang and E.A. Irene, *J. Vac. Sci. Technol. B*, **14**, 2543 (1996).
183. "Design and Construction of a Rapid Thermal Processing System for in-situ Optical Measurements", K.A. Conrad, R.K. Sampson, H.Z. Massoud and E.A. Irene, *Rev. of Scientific Instruments*, **67**, 3954 (1996).
184. "In-Situ Ellipsometry for Monitoring Nucleation and Growth of Silicon on Silicon Dioxide", C. Basa, Y.Z. Hu and E.A. Irene, Presented at Second International Conference on Spectroscopic Ellipsometry, ICSE-2, Charleston SC, May 12-15, 1997, *Thin Solid Films*, **313-414**, 424 (1998).
185. "A Square Law for the Analysis of Real Time Ellipsometric Nucleation and Growth Data", Y.Z. Hu C.Y. Zhao, W.X. Gao and E.A. Irene, Presented at Second International Conference on Spectroscopic Ellipsometry, ICSE-2, Charleston SC, May 12-15, 1997, *Thin Solid Films*, **313-414**, 416 (1998).
186. "An In and Ex-Situ Ellipsometry Comparison of the Interfaces on Si and GaAs Resulting from Thermal and Plasma Oxidation", P.R. Lefebvre, C. Zhao and E.A. Irene, Presented at Second International Conference on Spectroscopic Ellipsometry, ICSE-2, Charleston SC, May 12-15, 1997, *Thin Solid Films*, **313-414**, 454 (1998).
187. "A Spectroscopic Immersion Ellipsometry Study of SiO_2 -Si Interface Roughness for Electron Cyclotron Resonance Plasma and Thermally Oxidized Si Surfaces", C. Zhao, P.R. Lefebvre and E.A. Irene, Presented at Second International Conference on Spectroscopic Ellipsometry, ICSE-2, Charleston SC, May 12-15, 1997, *Thin Solid Films*, **313-414**, 286 (1998).

188. "Ultrathin SiO₂ Film Measurements Using Fowler-Nordheim Tunneling Current Oscillations", E.A. Irene, Presented at and published in Proceedings of the "2nd International Symposium on "Advanced Science and Technology of Silicon Materials", Hawaii, Nov 25-29, 1996.
189. "In Situ Surface Pretreatment Effect on Nucleation and Film Structure of Polysilicon in a RTCVD System", Y.Z. Hu, S.P. Tay, C.Y. Zhao, E.A. Irene, K.N. Christensen and D.M. Maher, Presented at and published in Proceedings of "4th International Conference on Advanced Thermal Processing of Semiconductors, Boise ID, Sept. 11-13, 1996, p128.
190. "A Study of the Mechanisms of GaN Film Growth on GaAs Surfaces by Nitrogen Thermal and Plasma Nitridation", M. Losurdo, P. Capezzuto, G. Bruno, P.R. Lefebvre and E.A. Irene, J. Vac. Sci. Technol. B, 16(5) 2665 (1998).
191. "A Spectroscopic Anisotropy Ellipsometry Study of YBa₂Cu₃O_{7-δ} Superconductors", A. Michaelis, E.A. Irene, O. Auciello, A.R. Krauss and B. Veal, Thin Solid Films, 313-414, 362 (1998).
192. A An Atomic Force Microscopy and Ellipsometry Study of the Nucleation and Growth Mechanism of Polycrystalline Silicon Films on Silicon Dioxide@ C. Basa, M. Tinani and E.A. Irene, J. Vac. Sci. Technol. A, 16(4), 2468 (1998).
193. AStudies of Ferroelectric Film Growth Processes Using In Situ, Real-Time Ion Beam Analysis@, A.R. Krauss, O. Auciello, J. Im, V. Smentkowski, D.M. Gruen, E.A. Irene and R.P.H. Chang, Integrated Ferroelectrics, 18, 351 (1997).
194. AArea Evaluation of Microscopically Rough Surfaces@ L.Lai, and E.A. Irene, J. Vac. Sci. Technol. B, 17, 33 (1999).
195. AA Study of the Relationship Between Si/SiO₂ Interfaces Charges and Roughness@, L.Lai, K.J. Hebert and E.A. Irene, J. Vac. Sci. Technol. B, 17, 53 (1999).
196. AAn Ellipsometric Investigation of Nucleation Sites for Chemical Vapor Deposition of Si on SiO₂ and Si₃N₄ Surfaces@, C. Basa, and E.A. Irene, J. Vac. Sci. Technol. A, 17, 817 (1999).
197. AA Study of the Effects of Ion Surface Treatments on the Nucleation of Si on SiO₂ Surfaces@, C. Basa, Y.Z. Hu, M. Tinani and E.A. Irene, Proceedings of the Materials Research Society, April (1998).
198. AComparison of Si/SiO₂ Interface Roughness from Electron Cyclotron Resonance Plasma and Thermal Oxidation@, C. Zhao, Y.Z. Hu, T. Labayen, L. Lai and E.A. Irene, J. Vac. Sci. Technol. A, 16, 57, (1998).

199. A GaN Neutron Transmutation Doping with Ge⁺, L.Y. Krasnobaev, J.J. Cuomo, N. El-Masry, P.B. Perez, C. Mayo, V.A. Joshkin, E.A. Irene, A. Suvkhanov, N. Parikh and J. Van Hove, Proceedings of the Materials Research Society, April 1998.
200. A Comparison of the Structure and Electrical Properties of Thermal and Plasma Grown Oxides on GaAs⁺, P.R. Lefebvre, L. Lai and E.A. Irene, J. Vac. Sci. Technol. B, 16, 996 (1998).
201. A An In-Situ Study of Interface Reactions of Ion Beam Sputter Deposited (Ba_{0.5}Sr_{0.5})TiO₃ Films on Si, SiO₂ and Ir⁺, Y. Gao, A. Mueller, E.A. Irene, O. Auciello, A. Krauss and J. A. Schultz, J. Vac. Sci. Technol. A, 17, 1880 (1999).
202. A Chemistry and kinetics of the GaN formation by plasma nitridation of GaAs: An in-situ real time ellipsometric study⁺, M. Losurdo, P. Capezzuto, G. Bruno, and E.A. Irene, Phys. Rev B., 58, 15879 (1998).
203. A III-V Surface Plasma Nitridation: A Challenge for III-V Nitride Epigrowth⁺, M. Losurdo, P. Capezzuto, G. Bruno and E.A. Irene, J. Vac. Sci. Technol. A, 17, 2194 (1999).
204. A High density plasma deposition of device quality silicon nitride: II. Effect of thickness on electrical properties⁺, M.C. Hugon, F. Delmotte, B. Agius and E.A. Irene, submitted October 1998.
205. A Effects of ion pretreatments on the nucleation of silicon on silicon dioxide⁺, C. Basa, and E.A. Irene, J. Vac. Sci. Technol. A, 16, 3223 (1998).
206. A Limiting Si/SiO₂ Interface Roughness Resulting From Thermal Oxidation⁺, L. Lai and E.A. Irene, J. Appl. Phys., 86, 1729 (1999).
207. “Consistent Refractive Index Parameters for Ultra-Thin SiO₂ Films”, Y. Wang and E.A. Irene, J. Vac. Sci. Technol. B, 18(1), 279 (2000).
208. “Combined Spectroscopic Ellipsometry and Ion Beam Surface Analysis for *In Situ* Real-Time Characterization of Complex Oxide Film Growth”, A.H. Mueller, Y. Gao, E.A. Irene, O. Auciello, A.R. Krauss and J.A. Schultz, Proceedings of the Materials Research Society, Volume 569, Eds. O. Auciello, A.R. Krauss, E.A. Irene and J. A. Schultz, p15, April 1999.
209. “*In Situ* Real -Time Ellipsometry Study of Dynamic Processes of YBa₂Cu₃O_{7-x} Thin Films”, Y. Gao, A.H. Mueller, E.A. Irene, O. Auciello, A.R. Krauss and J.A. Schultz, Proceedings of the Materials Research Society, Volume 569, Eds. O. Auciello, A.R. Krauss, E.A. Irene and J. A. Schultz, p77, April 1999.
210. “*In-Situ* Real Time Studies of Nickel Silicide Formation”, M. Tinani, E.A. Irene, Y.Z.

Hu and S.P. Tay, Proceedings of the Materials Research Society, Volume 569, Eds. O. Auciello, A.R. Krauss, E.A. Irene and J. A. Schultz, p121, April 1999.

211. “Studies of Ferroelectric Heterostructure Thin Films and Interface Via *In Situ* Analytical Techniques”, O. Auciello, A.R. Krauss, J. Im, A. Dhote, D.M. Gruen, E.A. Irene, Y. Gao, A.H. Mueller and R. Ramesh, *Integrated Ferroelectrics*, **27**, 103 (1999), and presented International Workshop on Ferroelectric and High Dielectric Thin Films, Puerto Rico, May 12-15 1999.

212. “Si/SiO₂ Interface Roughness Study Using Fowler-Nordheim Tunneling Current Oscillations”, L. Lai and E.A. Irene, *J. Appl. Phys.*, **87**, 1159 (2000).

213. “Real-Time Study of Oxygen in c-Axis Oriented YBa₂Cu₃O_{7-x} Thin Films Using Spectroscopic Ellipsometry”, Y. Gao, A.H. Mueller, E.A. Irene, O. Auciello, A.R. Krauss and J.A. Schultz, *J. Appl. Phys.*, **86**, 6979 (1999).

214. “*In situ* Real-Time Studies of Nickel Silicide Phase Formation”, M. Tinani, A. Mueller, Y. Gao, E.A. Irene, Y.Z. Hu and S.P. Tay, *J. Vac. Sci. Technol. B*, **19**, 379 (2001).

215. “Nitridation of Thermal SiO₂ Films by Radio-Frequency Plasma Assisted Electron Cyclotron Resonance: Effect of Plasma Modes and Process Parameters”, A. Raveh, J. Brewer and E.A. Irene, *J. Vac. Sci. Technol. A*, **19**, 9 (2001).

216. “High density plasmas for micro- and optoelectronics processing”, F. Delmotte, M.C. Hugon, B. Agius, E.A. Irene, *Le vide n°291 - volume 1/4*, **11**, (1999).

217. “Ultra-thin SiO₂ film studies: index, thickness, roughness and the initial oxidation regime”, E.A. Irene, *Microelectronics Reliability*, **40**, 563 (2000).

218. “An electrical study of a thin film poly(*o*-methoxyaniline) field effect transistor”, R.F. Bianchi, R.K. Onmori, D. Goncalves, A.M. Andrade, R.M. Faria and E.A. Irene, presented at the International Conference on Science and Technology of Synthetic Metals-ICSM, July 15-21 2000, Gastein Austria and published in *Synthetic Metals* **121**, 1687 (2001).

219. “Nitridation of Thermal SiO₂ Films by Radio-Frequency Plasma Assisted Electron Cyclotron Resonance: Layer Structure and Composition”, A. Raveh, J. Brewer and E.A. Irene, *J. Vac. Sci. Technol. A*, **19**, 17 (2001).

220. “Electroluminescence in silicon oxynitride films”, K.J. Price, L.R. Sharpe, L.E. McNeil and E.A. Irene, *J. Appl. Phys.*, **86**, 2638 (1999).

221. Chapter 3 “*In Situ* Real-Time Characterization of Surfaces and Film Growth Processes Via Ellipsometry”, by E.A. Irene in “*In Situ* Real-Time Characterization of Thin Films”, Eds, O. Auciello and A. B. Krauss, Wiley Interscience, pps 57-104 (2001).

222. "A Study of Gold Coated Glass as Electrodes for Electropolymerization of 3-Methylthiophene", D. Goncalves and E.A. Irene, *Langmuir*, **17**, 5031 (2001).
223. "Ultra-thin SiO₂ film studies: index, thickness, roughness and the initial oxidation regime", E.A. Irene, *Solid State Electronics*, **45**, 1207 (2001).
224. "Fundamentals and Applications of Spectroscopic Ellipsometry", D. Goncalves and E.A. Irene, *Quimica Nova (Brazil)*, **25**, 794 (2002).
226. "Real Time Observations of Interface Formation for Barium Strontium Titanate Filma on Silicon", A.H. Mueller, N.A. Suvorova, E.A. Irene, O. Auciello and J.A. Schultz, *Applied Physics Letters*, **80**, 3796 (2002).
227. "Sensitivity in extracting static dielectric constants from multiple film stacks", A.H. Mueller, N.A. Suvorova and E.A. Irene, *Applied Physics Letters*, **80**, 3596 (2002).
228. "Ellipsometry Study of the Photo-Oxidation of poly[(2-methoxy-5-hexyloxy)-*p*-phenylenevinylene] ", R.F. Bianchi, D.T. Balogh, M. Tinani, R.M. Faria and E.A. *Journal of Polymer Science B-Polymer Physics*, **42** (6) 1033-1041 (2004).
229. Chapter 8 "SiO₂ Films" by E.A. Irene in "Handbook of Ellipsometry" Eds. H.G. Tompkins and E.A. Irene, William Andrew Publishing Noyes Publications, p 569-636, 2005.
230. Chapter 2 "SiO₂ Based MOSFET's:Film Growth and Si-SiO₂ Interface Properties" by E.A. Irene in "High Dielectric Constant Materials for VLSI MOSFET Applications" Eds. H.K. Huff and D. Gilmer, Springer Series in Advanced Microelectronics, 2005.
231. "Photo-oxidation phenomenon of MH-PPV films studied by ellipsometry and infrared spectroscopy",R.F. Bianchi, D.T. Balogh, D. Goncalves, R.M. Faria and E.A. Irene, *Molecular Crystals and Liquid Crystals*, **374**, 457-462 (2002).
232. "A Model for Interface Formation and the Resulting Electrical Properties for Barium Strontium Titanate Films on Silicon", A.H. Mueller, N.A. Suvorova, E.A. Irene, O.Auciello and J.A. Schultz, *J. Appl. Phys.*, **93**, 3866 (2003).
233. "Anisotropy of Optical Functions of Conjugated Polymer Thin Films by Spectroscopic Ellipsometry, Maria Losurdo, Giovanni Bruno and Eugene A. Irene, *J. Appl. Phys.*, **94**, 4923 (2003).
234. "The protective nature of dodecanethiol self-assembled monolayers deposited on Au for the electropolymerization of 3-methylthiophene" D. Goncalves and E.A. Irene, *Electrocatalysis*, **15**, 652 (2003).

235. "Comparison of interfaces for (Ba,Sr)TiO₃ films deposited on Si and SiO₂/Si substrates", N.A. Suvorova, C.M. Lopez, E.A. Irene, A.A. Suvorova and M. Saunders, , *J. Appl. Phys.*, **95**, 2672 (2004).
236. "Electronics Materials Science" E.A. Irene, Textbook, Wiley. Published 2005. ISBN 0-471-69597-1
237. "Hybrid titanium-aluminum oxide layer as alternative high-k gate dielectric for the next generation of complimentary metal-oxide-semiconductor devices", O. Auciello, W. Fan, B. Kabius, S. Saha, J.A. Carlisle, R.P.H. Chang, C. Lopez, E.A. Irene and R.A. Baragiola, *Appl. Phys. Lett.*, **86**, 042904 (2005).
238. "Optical properties of N,N'-bis (3-phenoxy-3-phenoxy-phenoxy)-1,4,5,8-naphthalenetetracarboxylic diimide by spectroscopic ellipsometry", D.X. Yang, R. Shrestha, T. J. Dingemans, E.T. Samulski and Eugene A. Irene, *Thin Solid Films*, **500**, 9 (2006).
239. "A Study of the ZrO₂ Film Interfaces with Si and SiO₂", C.M. Lopez, A.A. Suvorova, M. Saunders and E.A. Irene, *J. Appl. Phys.*, **98**, 033506 (2005).
240. "Ellipsometry Study of Poly(o-methoxyaniline), Thin Films", R. Shrestha, D. X. Yang, E. A. Irene , *Thin Solid Films*, **500**, 252 (2006).
241. "A Study of HfO₂ Film Interfaces with Si and SiO₂" C.M. Lopez and E.A. Irene, *J. Appl. Phys.*, **99**, 024101 (2006).
242. "An Ellipsometric Study of Polymer Film Curing: 2,6-bis(3-aminophenoxy) Benzonitrile /4,4' Oxidiphthalic Anhydride Poly(amic acid)", Li Yan, C. Park, Z. Ounaies^c, and E. A. Irene, *Polymer*, **47** , 2822 (2006).
243. "Magnesium Oxide as a Candidate High-K Gate Dielectric", L. Yan, C. M. Lopez, R. P. Shrestha, and E. A. Irene, A. A. Suvorova and M. Saunders, *Appl. Phys. Lett.*, **88**, (2006).
244. "A Study of the Optical and Electronic Properties of Poly(Vinylidene Fluoride-Trifluoroethylene) Copolymer Thin Films", Y.X. Li, L Yan, R.P. Shrestha, D. Yang, Z. Ounaies and E.A. Irene, *Thin Solid Films*, **513**, 283 (2006).
245. " HF Etchant Solutions in Supercritical Carbon Dioxide for Dry Etch Processing of Microelectronic Devices", C.A. Jones, D. Yang, E.A. Irene, S.M. Gross, M. Wagner, J. DeYoung and J.M. DeSimone, *Chem. Mater.*, **15**, 2867 (2003).
246. "Etching SiO₂ Using HF/Pyridine Dissolved in Supercritical Carbon Dioxide and Resultant Interfacial Electronic Properties" Yuxiang Li, Dongxing Yang, Charles A. Jones, III, Joseph M. DeSimone, and Eugene A. Irene, *J. Vac. Sci Technol. B*, **25**, 1139 (2007).

247. "Characterization and Optimization of a P-Channel Poly(*O*-Methoxyaniline) Based Thin Film Transistors", R. P. Shrestha, D. Yang, Y. X. Li, L. Yan, E. A. Irene, *J. Vac. Sci. Technol. B*, 24, 2731 (2006).
248. "Electronic and Device Properties of a New Naphthalenetetracarboxylic Diimide Derivative", D. Yang, R.P. Shrestha, Y.X. Li, L. Yan, E.A. Irene, *J. Vac. Sci. Technol. B*, 24, 2653 (2006).
249. "A study of poly(vinylidene fluoride-trifluorethylene) as a potential organic high K gate dielectric", Y.X. Li, L Yan, R.P. Shrestha, D. Yang, and E.A. Irene, *J. Vac. Sci. Technol. A*, 25, 275 (2007).
250. "Er₂O₃ as a candidate high-K dielectric", M. Losurdo, M. M. Giangregorio, G. Bruno, D. Yang, E. A. Irene, A. A. Suvorova and M. Saunders, *Appl. Phys. Lett.*, 91, 091914 (2007).
251. "Multifunctional nanocrystalline thin films of Er₂O₃ : interplay between nucleation kinetics and film characteristics", M. Losurdo, M. M. Giangregorio, P. Capezzuto, G. Bruno, R.G. Toro, G. Malandrino, I.L. Fragala, L. Armelao, D. Barreca, E. Tondello, A. A. Suvorova, D. Yang and E. A. Irene, *Advanced Functional Materials*, 17, 3607 (2007).
252. "Surfaces, Interfaces and Thin Films for Microelectronics" E.A. Irene, Textbook, Wiley. Published February 2008. ISBN 978-0-470-17447-0.
253. "Surface Characterization of Adsorbing Polymer Films Deposited on Transparent Glasses", D. Goncalves, S.A. Travain, J.A. Giacometti and E.A. Irene, *e-Polymers*, 012, (2008).

