EUGENE A. IRENE

EDUCATION

B.S. Chemistry, Manhattan College 1963
Ph.D. Solid State Chemistry, Rensselaer Polytechnic Institute 1972

EMPLOYMENT-EXPERIENCE-AWARDS

1982 - Present **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 Measure-ments - 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; Instruc-tor; 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 SiO_2 Films and the Si-SiO_2 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/SiO_2 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-SiO_2 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 SiO_2 Films

21. Changyi Zhao, Ph.D. 1997: A Study of Si/SiO_2 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/SiO_2 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, PhD. 2002: *In Situ* Real-Time Analysis of Complex Oxide Film Growth

28. Jason Brewer, "Plasma Nitrided SiO_2 Studies", 2003.

29. Natalya Suvorova, "High Dielectric Constant Complex Oxides for Microelectronics", April

2004.

30. Ciro Lopez, "A Study of HfO_2 and ZrO_2 Interfaces with Si and SiO_2", March 2005.

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

32. Dongxing Yang, "A Study of the Optical and Electronic Properties of Organic Thin film Transistors Based on Napthalenetetracarboxylic 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, $GeSe_2$ 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. Zirinksy 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 SiO_2 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 H_2O," E.A. Irene and R. Ghez, J. Electrochem. Soc.,

124, 1757 (1977).

15."Expansion of Thermally Grown SiO_2 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 SiO_2 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 SiO_2 Films," E.A. Irene, Proceedings of International Topical Conference on the Physics of SiO_2 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 SiO_2 at 295☜K and 75☜K," 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 SiO_2 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 SiO_2 and Si_3N_4," 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 SiO_2 Films," E.A. Irene, J. Electrochem. Soc., 129, 413 (1982).

32."Evidence for a Parallel Path Oxidation Mechanism at the Si-SiO_2 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 SiO_2 at Low Oxidation Temperatures," E.A. Irene, E. Tierney, and J. Angilello, J. Electrochem. Soc., 129, 2594 (1982).

35."Oxidation of Silicide Thin Films: $TiSi_2$," 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 SiO_2 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 SiO_2 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 SiO_2 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 SiO_2 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-SiO_2 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."SiO_2 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 SiO_2 and the Si-SiO_2 Interface," Ed C.R. Helms and B.E. Deal, Plenum, New York, 61 (1988).

74."An In-Situ Ellipsometric Study of Aqueous NH_4OH 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 SiO_2 Films, G. Lucovsky, J.T. Fitch, E. Kobeda and E.A. Irene, "The Physics and Chemistry of SiO_2 and the Si-SiO_2 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, SiO_2", J.T. Fitch, E. Kobeda, G. Lucovsky 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 SiO_2 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-SiO_2 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. Buaud, 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).

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