BIOGRAPHICAL SUMMARY OF ROBERT J. NEMANICH

Business Address

Department of Physics
Arizona State University
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Education

Joliet Junior College	1965-67		
Northern Illinois University	1969	B.S.	Physics
Northern Illinois University	1971	M.S.	Physics
The University of Chicago	1977	Ph.D.	Physics

Industrial and Academic Positions

1976-1986	Member Research Staff, General Sciences Laboratory (76-82), Project Leader, Integrated Circuit Laboratory (82-85), Senior Member Research Staff and Acting Area Manager, General Sciences Laboratory (85-86), Xerox Palo Alto Research Center, Palo Alto, California
1986-1990	Associate Professor, Department of Physics, and Associate Member, Dept of Materials Science and Engineering, North Carolina State University.
1990-2006	Professor, Department of Physics, and Associate Member of the Department of Materials Science and Engineering, Acting Associate Dean of Research (2/2000 through 1/2001), North Carolina State University.
2006-present	Professor and Chair, Deaprtment of Physics, Arizona State University.

Society Memberships

American Physical Society (Fellow, 1994)
Materials Research Society (Past President, President: 1998)
International Union of Materials Research Societies (Past President, President: 2003-2004)
Electrochemical Society
Sigma Xi

Fields of Research Interest

Diamond and other wide bandgap semiconductors, Nanostructures, Semiconductor surface processing, Heteroepitaxy on Si, Silicide formation, Raman scattering, and Surface science

Awards

NC State Alumni Association's Outstanding Research Award 1994
NC State Alumni Association's Distinguished Graduate Professorship 2001

Contents:

1. Students

Graduate Students

Charles Doland, PhD., Univ of Houston (Adjunct Faculty), Spring 88, "Molybdenum Silicide Formation on Single Crystal, Polycrystallilne and Amorphous Silicon: Growth, Structure and Electrical Properties."

Robert E. Shroder, MS, Fall 88 (Current Address; TWR, Redondo Beach, CA (as of 12/96), "Diamond and Diamond-Like Thin Films: A Raman Scattering Analysis of Carbon Bonding."

Robert Fiordalice, MS, Fall 88 (Current Address; Motorolla APRDL, Austin, TX), "Raman Characterization of the Ti/Si Thin Film System."

Yvonne LeGrice, MS, Fall 89 (Current address; Applied Materials), "Raman and Infrared Characterization of Diamond Thin Films."

Hyeongtag Jeon, (PhD, Materials Science and Engineering), Fall 90 (Current address Honyang University), "Initial Reactions, Surface and Interface Morphologies, Phases Transition, and Epitaxial Growth of $TiSi_2$ Formed by Thin Film Reaction in Ultrahigh Vacuum."

John LaBrasca, MS, Spring 91 (Current address: Intel, Portland, OR), "Scanning Tunneling Microscopy and Spectroscopy of Doped Silicon and Titanium Silicide Thin Films."

Cathy Sukow, MS, Fall 92 (Current address; Brandeis University - Biophysics program), "Morphology and Mechanisms of $ZrSi_2$ and $TiSi_2$ on Silicon."

Jaewon Cho, PhD, Fall 92 (Current address; Seoul, Korea), "Surface Structure and Surface Electronic States Related to Plasma Cleaning of Si and Ge."

Kevin Turner, PhD, Fall 92 (Current address; Naval Research Laboratories), "A Study of the Nucleation and Growth of Diamond on Silicon by Scanning Tunneling Microscopy and Spectroscopy."

Jaap van der Weide, (PhD) Fall 93, (Current Address: Waltham, MA) "Properties of Diamond Surfaces and Metal-Diamond Interfaces: Schottky Barrier Heights and Negative Electron Affinity Effects."

Thomas Schneider, (PhD) Spring 94, (Current Address: Texas Instruments, 13536 N. Central Expressway, MS 944, Dallas, TX 75243) "Hydrogen Plasma Interactions with Silicon Surfaces."

Shawn Wagoner, (MS) Summer 94, (Current Address: Micron Technology, Boise, ID). "Nucleation and Growth of Homoepitaxial Diamond Films."

Julian Selvaraj, (MS) Summer 94, (Current Address: Intel Corp, Oregon) "Photophoretic Deflection of Particles in Subatmospheric Pressure Chambers."

Terri McCormick, (MS chair) Summer 1994 "The Characterization of Strain, Impurity Content and Crush Strength of Single Crystal Diamonds." (Current Address: Harris Semiconductor, Melbourne FL. (Senior Reliability Engineer).

David Aldrich, (PhD co-chair) Spring 1995 "Characterization of the Solid Phase Reaction of Titanium with Silicon Germanium Alloys: Interface Reactions, Phase Formation, and Stability." Current Address: Texas Instrument, Semiconductor Process & Design Center, Dallas, TX.

Leah Bergman, (PhD chair) Spring 1995). "Photoluminescence and Raman Analysis of Impurities and Defects in Diamond Films." Current Address: University of Idaho, Moscow, Idaho.

Eric Watko, (MS chair) Spring 1995 "In situ Characterization of Oxide Thin Film Growth."(Current Address: Raleigh, NC)

Mike Powers, (MS chair) Summer 1995)."Photoemission from BN and Secondary Electron Emission from Negative Electron Affinity Surfaces." Current Address: MKE Quantum Components, Shrewsbury, MA.

Yuan Dao, (PhD co-chair) Fall 1995 "Growth and Characterization of ($Ti_{1-x}Zr_xSi_2$) Thin Films on Silicon." Current Address: Texas Instrument, Dallas, TX.

Jay Montgomery, (PhD chair) December 14, 1995. "Materials and Device Analysis of Hydrogen Plasma Prepared Silicon Surfaces," Current Address: Intel, Santa Clara, CA.

Ja-Hum Ku, (PhD chair) December 19, 1995 "Properties of Si_xGe_{1-x} Alloy Surfaces and Co/Si_xGe_{1-x} Interfaces." Current Address: Samsung Electronics, Korea.

Michael Netzer, (MS chair), November 1996 "Emission Studies of Diamond and Cubic Boron Nitride Crystallites Bonded to Metalllic Substrates." Current Address: Harris Semiconductor, P. O. Box 883, MS 59-055, Melbourne, FL 32902-0883.

Sean King, (PhD co-chair) March 25, 1997, "Surface and Interface Characterization of SiC and III-V Nitrides." Current address: Intel, RA1-234, 5200 NE Elam Young Pkwy, Hillsboro, OR 97124-6497.

John Barnak, (PhD chair) June 24, 1997 "Processing of Si(100) Surfaces by a Remote RF H_2 and H_2/SiH_4-Plasma to Remove Surface Contaminants". Current Address: Intel, Oregon

Peter Baumann, (PhD chair) July, 1997 "Electron Affinity and Electron Emission from Diamond Surfaces and Metal-Diamond Interfaces." Current Address: Aixtron, Germany.

Mark Benjamin, (PhD chair) December 1997, "Electronic Properties of SiC and AlN Surfaces and Interfaces." Current Address: new job as of Spring 2002.

Andy Stoltz (MS) January 1998, "Interface Stability of Tintanium Silicide on 6H-Silicon Carbide (0001)." Current Address: Triangle, VA.

Steve English (MS chair) September 1998, Current Address: Allied Signal, Maryland, "Photoemission Electron Microscopy of Diamond Thin Films."

Hong Ying, (PhD chair) October 1998, "In-Situ Remote RF Plasma Cleaning and Surface Characterization after SiO_2/Si RIE." Current Address: LSI Logic, San Jose,CA.

Ambika Somashekhar Carter (MS chair) October 1998, "The Investigation of Hydrogen Plasma Processing for Backend Cleaning."Current Address: IMEC, Leuven, Belgium

Andy Sowers, (PhD chair) January 1999, "Characterization of Field Emission Properties of Nitrogen-Doped Diamond." Current Address: Intel, San Jose, CA.,

Peter Goeller, (PhD co-chair) May 1999, "Cobalt Disilicide Contacts to $Si_{1-x}Ge_x$ Alloys." Current Address: Texas.

Jim Christman, (PhD chair), August 1999, "Piezoelectric Measurments Using an Atomic Force Microscope." Current Address: Intel, San Jose, CA,

Richard J. Carter, (PhD chair) September 1999, "Surface Morphology and Chemical Characterization of Si Surfaces Prepared with HF/Alcohol Vapor Phase Chemistries." Current Address: Post Doc at IMEC, Leuven, Belgium.

Hoon Ham, (PhD chair) November 1999, "Scanning Tunneling Microscopy of Nanoscale Structures of Titanium Disilicide on Clean Silicon Surfaces."Current Address: Serome Ventures, Korea.

Michael O'Brien, (PhD chair) October 1999, "Photoemission of Silicon Carbide Surfaces and Interfaces." Current Address: Northrup-Grumann, Maryland.

Brandon L.Ward, (PhD chair), February 2000, "Correlation of Surface Properties with Electron Emission Characteristics for Wide Bandgap Semiconductors." Current Address: Intel Corp., Santa Clara, CA.

Kieran M. Tracy, (PhD co-chair) September 2000, "Deposition and Electrical, Chemical and Microstructural Characterization of the Interface Formed between Pt, Au and Ag Rectifying Contacts and Cleaned n-typed GaN (0001) Surfaces." Current Address: Intel Corporation, Santa Clara, CA.

Jeff Hartman, (PhD co-chair) October 2000, "Characterization of the Growth of Aluminum Nitride and Gallium Nitride Thin Films on Hydrogen Etched and/or cleaned 6H-SiC(0001) Surfaces." Current Address Northrup-Grumann, Maryland.

Christian Petrich, (MS). Dec. 2000, Current Address: New Zealand, "Thermostability of the 6H-SiC(0001)Si Surface Observed with Photo-Emission Electron Microscopy (PEEM)."

Woochul Yang, (PhD chair), February 2001, "In Situ, Real Time Characterization and Growth of Metal Silicide Islands on Si Surfaces by Photo Electron Emission Microscopy," Current Address: NCSU, Post doc.

Jaehwan Oh (PhD chair), July 2001, "Electrical Characterization of $TiSi_2$ Nanoscale Islands by Scanning Probe Microscopy." Current Address: Intel, Hillsboro, Oregon.

Morgan Ware (PhD chair), January 2002, "Effects of Strain Relaxation in SiGe Growth on Uniquely Oriented Si Substrates." Current Address: Naval Research Lab, Washington, DC.

Philip Hartlieb (PhD-co-chair), February 2002, "Electrical, Chemical, and Structural Characterization of the Interface Formed between Ni/Au and Pd/Au Ohmic Contacts and Cleaned p-type GaN (0001) Surfaces," Current address: Clemson University.

Franz A. M. Koeck (MS chair), 2003 "Thermionic Emission from Doped and Nanocrystalline Diamond"

Ted Cook, Jr. (PhD co-chair), May 2003, "Photoemission Investigation of the Electronic Properties of Ga-Face GaN (0001)-Dielectric Interfaces"

Jaeseob Lee (PhD co-chair), May 2003 "Direct Bonding of Gallium Nitride to Silicon Carbide: Physical, and Electrical Characterization" (Current address: Univ of Ill., Post doc)

Brian Coppa (PhD co-chair) June 2003, "Electrical, Chemical, and Structural Characterization of Au Schottky Contacts on Remote Plasma-Treated n-Type ZnO{0001}" (Current address: Micron Semiconductor, Idaho)

Brian Rodriguez (PhD chair) Oct. 2003 "Nanoscale Investigation of the Piezoelectric Properties of Perovskite Ferroelectrics and III-Nitrides," (current address: NC State, post doc.)

James Burnett, (PhD co-chair) March 2, 2004 "Formation of Metal Silicide and Metal Germanosilicide Contacts to $Si_{1-x}Ge_x$ Alloys,"

Yunyu Wang, (PhD chair) Oct. 29, 2004, "Synthesis and Field Emission Properties of Carbon Nanotube Films," (current address: Univ of Texas, post doc)

Jennifer Huening, (MS chair) Nov. 01, 2004, "Raman Scattering Analysis of Structural Transformations due to Precision Engineered Si, 6H-SiC and B-Si_3N_4," (Current Address: Intel, Hillsboro, Oregon)

Charles Fulton (PhD chair) Aug 2005 "Spectroscopic Study of the Interface Chemical and Electronic Properties of High-K Gate Stacks," (Current address: Intel, Phoenix AZ)

Jacob Garguilo (PhD Chair) Nov 2006, "Electronic Transition Imaging of Carbon Based Materials: The Photothreshold of Melanin and Thermionic Field Emission from Diamond"

Matt Zeman (PhD)
Yingjie Tang (PhD)
Joshua Smith (PhD)
Eugene Bryan (MS)
Anderson Sunda-Meya (PhD)
Xinhua (Wendy) Kong (PhD)
Leigh Winfrey (PhD)
James Perkins (PhD)
Joe Tedesco (PhD)
Jacqueline Hanson (PhD)
Benjamin Gilbert (MS)
Jiyoung Choung (PhD)
Ed Hurt (MS)

Post Docs/Visiting Scholars Mentored

Leah Bergman
Boyan Boyanov
Y. L. Chen
Anne Edwards
Trevor Humphries
Hyeongtag Jeon
Eliane Maillard-Schaller
Koichi Naniwae, Visiting Scholar
Willie Platow
Arilza de Oliveira Porto, Visiting Scholar
Zhihai Wang
Peichun Yang
Woochul Yang
Sanju Gupta
Brian Rodriguez

International Visiting Students (Diplom research etc.)

Boike Kropman, 92, (Twente University, Holland)
Michiel Slotboom, 93, (Twente University, Holland)
Rob Analbers, 94, (Twente University, Holland)
Friso Jedema, 96 (Twente Univesity, Holland)
Christian Koitzsch (Technische Universitat Ilmenau, Germany 7/97-10/98)
Christian Petrich (August 1998-August 2000)
Peter Laloli, (Twente University, Holland August-December 1998)
Edwin Jellema, (Twente University, Holland May-August 1999)
Lena Fitting, 8/01-8/02 (Rostock University, Germany)
Marcel Himmerch, 3/31/03-10/10/03
Roland Koch, 6/04-7/04, 6/05-8/05
Nina Malchus 1/06-5/06

Undergraduate Students (years of participation)

Mark Miller 87, 88
Mike Reid 88, 89
James Parks 89, 90
Shannon Wells 90 (Marsh-White Award at SESAPS)
Eugen Buehler 89,90,91 (Marsh-White Award at SESAPS and fellowship to attend Int. Conf. Of Physics Students, Vienna, Austria)
Joffa Applegate 91
Greg Newman 91
Paul Fullbright 91
Barbara Bernhard 92
Robert Corbett, 92, 93
Richard Carter, 92, 93, 94
Daniel Cartin , 92
Bart Lambers, 94,
Jens Engemann, 94
Holly Heck, 94 (REU)
Jesse Frye, 94 (REU)
Stephen Ellis, 95, 96, 97
Steven English, 95
Richard Busby, 95 (REU)
David Mathes, 95 (REU)
Darci Allen, 96 (REU)
Ted Cook, 96, 97 (REU)
Robin LaSalle, 96 (REU)
Svjetlana Pejdo 96, 97, 98
Rebecca Beauchamp (Summer 1997 REU)
Nicole Morgan (Summer 1997 REU, Fall 1997)
Brett Connor Fall 97, Spring 98
Erica Robertson, Fall 97, Spring 98 (Recipient of MRS Undergraduate Research Award)

Jessica Hauser (REU Summer 1998)
Patrick Murphy (REU Summer 1998)
Ted Cook (Summer 1998)
Nithin Reddy (Science House High School Program Summer 1998)
Jeremy Katz (Science House High School Program Summer 1998)
Nathan George, Spring 99,
Eugene Bryan, Spring 99-Summer 2000
Chris Hinkle, Spring 99
Ian Makey, Summer 1999 REU
Mike Muglia, Summer 1999 REU
Billyde Brown, Summer 1999 ARO, Fall 1999-Summer 2003
Reece Haywood, Summer 2000, REU
Berhane Temelso, Summer 2000, REU
Matt Zeman, Summer 2000, REU
David Baker, Summer 2001, REU
Brian Davis, Summer 2001, REU
Kandace Tanner, Summer 2001, REU
Sally Royo, Spring 2002
Brendan Shields, Summer 2002, REU
Jennifer Huening, Summer 2002, REU
Michele Buddie, Summer 2002, REU
Rayshad Ali, Summer 2003, REU
Jeff Moeur, Summer 2003, REU
Wor Thongtei, Summer 2003, REU
Brenden Shields, REU/Enloe High School Student, Summer 03
Mengning Liang, 2003
Karen H. Spieler Canne 2003
John Waldrep 2003-2005
Claudia Williams 2003
Lucas Bilbro 2003-2005
Nicholas Johnson, Summer 2004, REU
Sarah E. Reising 2004-2005
Luke Postle 2005 REU
Roland Koch 2005 REU
Simon Stampe 2006 REU

2. Professional Activities

Co-chairman, Symposium on *Thin Films - Interfaces and Phenomenon*, Materials Research Society, Fall 1985.

Local Arrangements, 17th International Conference on the Physics of Semiconductors, 1984.

Publications Committee, Materials Research Society, 1987-1989.

Program Committee, Materials Research Society, 1988-1990.

Co-chairman, Symposium on *Heteroepitaxy on Silicon: Fundamentals, Structures and Devices*, Materials Research Society, Spring 1988.

Meeting Co-Chair, 1989 Fall Meeting of the Materials Research Society.
Co-chair, Diamond Optics, SPIE's 32 Annual Int. Technical Symposium.
Local Arrangements: 13th Int. Conference on Amorphous and Liquid Semiconductors - 1989.
Discussion Leader, Session Organizer, Gordon Research Conference on Inorganic Thin Films & Interfaces, 1989.
Member of Joint North Carolina/North Rhine-West Phalia Committee on Microstructures; Section Organizer, 1989-
Presidential Visit of Laboratory - February 2, 1990
Co-chair, Symposium on *Chemical Surface Preparation, Passivation and Cleaning for Semiconductor Processing,* Materials Research Society, Spring 1992.
Executive Committee (member at large), Division of Materials Physics, the American Physical Society, 92-95.
Chair, Continuing Education Committee, Materials Research Society (1992-1994).
Co-chair, Symposium on *Diamond, SiC and Nitride Wide Bandgap Semiconductors* Materials Research Society, Spring 1994
Co-chair, Symposium on *III-Nitride, SiC and Diamond Materials For Electronic Devices* Materials Research Society, Spring 1996
2nd Vice President of Materials Research Society (Elected), Jan-Dec 1996,
President Elect-Vice President, Materials Research Society, Jan-Dec 1997,
President, Materials Research Society, Jan-Dec 1998,
Past President, Materials Research Society, Jan-Dec 1999
Co-chair, Symposium on *Electron-Emissive Materials and Vacuum Microelectronics* Materials Research Society, Spring 2000
Program Committee: *Diamond Films 96-2006*
Editor-in-Chief, Diamond and Related Materials, 1999-present.
Vice President, International Union of Materials Research Society, 2000-2002
President, International Union of Materials Research Society, 2002-2004
Past President, International Union of Materials Research Society, 2004-2006
Co-chair, Symposium on *Nanostructured Diamond and Diamond-Like Materials for Micro- and Nanodevices* Materials Research Society, Spring 2005
Chair, Joint ICNDST-ADC-2006 *(International Conference on New Diamond Science and Technology and Applied Diamond Conference)* Research Triangle Park, NC, May 2006.
Co-Chair, CIMTEC 2006 (International Conference on Modern Mateials and Technologies), 4th Forum on New Materials, Acereale, Sicily, Italy, June 2006.

3. Policy and Professional Articles

"New Symposium Tutotial Program Debuts at the 1995 MRS Fall Meeting," R.J. Nemanich, MRS Bulletin 20, (11), p. 98-99, November 1995.

"Group III Nitrides for Field Emissions Displays," C. R. Bolognesi, *Compound Semiconductors, Second Annual Epitaxy Issue*, Vol. 3 (2) p. 10, March/April 1997.

"Still looking forward with the MRS way of doing things", R.J. Nemanich, MRS Bulletin 23, (1) p. 4, January 1998.

"MRS goes to Washington," R.J. Nemanich, R. Gibala, J.M. Phillips, R. Kelley, MRS Bulletin 23, (9), p. 14, September 1998.

"MRS Celebrates 25 Years," R. J. Nemanich, MRS Bulletin 23, (11), p. 5, November 1998.

"MRS Volunteers Contribute to Building a Professional Identity," R. J. Nemanich, MRS Bulletin 23, (12), p. 3, December 1998.

"Advancing the science and technology of diamond, diamond-like carbon, silicon carbides and Group 3 nitride materials," Robert J. Nemanich, editor-in-chief, *Diamond and Related Materials*, 2000, Jan., **9** (1):p. vii.

"Editorial," R.J. Nemanich, *Diamond and Related Materials*, (1), p. vii (2003).

4. Patents

"Ohmic Contacts for Hydrogenated Amorphous Silicon," 1985, No. 4,529,619. R.J. Nemanich and M.J. Thompson.

"High Temperature Refractory Silicide Rectifying Contact," 1991, No. 5,155,559. T. Humphreys, D. Thompson, S. Sahaida, R. Nemanich and K. Das.

"High Temperature Rectifying Contact and Method for Making Same," 1991, No. 5,212,401. T. Humphreys, K. Das and R. Nemanich.

5. Books Edited

1. Thin Films - Interfaces and Phenomena, edited by R.J. Nemanich, P.S. Ho and S.S. Lau, (Materials Research Society Symposia Proceedings, Vol. 54, 1986).

2. Heteroepitaxy on Silicon - Fundamentals, Structures and Devices, edited by H.K. Choi, R. Hull, H. Ishiwara, and R.J. Nemanich, (Materials Research Society Symposium Proceedings, Vol 116, 1988).

3. Chemical Surface Preparation, Passivation and Cleaning for Semiconductor Growth and Processing, edited by R.J. Nemanich, C.R. Helms, M. Hirose, and G.W. Rubloff, (Materials Research Society Symposium Proceedings, Vol 259, 1992).

4. Diamond, SiC and Nitride Wide Bandgap Semiconductors, edited by C.H. Carter, Jr., G. Gildenblat, S. Nakamura, and R.J. Nemanich, (Materials Research Society Symposium Proceedings, Vol 339, 1994).

5. III-Nitride, SiC and Diamond Materials for Electronic Devices, edited by D. Kurt Gaskill, Charles D. Brandt and Robert J. Nemanich, (Materials Research Society Symposium Proceedings, Vol 423, 1996).

6. Electron-Emissive Materials, Vacuum Microelectronics and Flat-Panel Displays, edited by K.L. Jensen, R.J. Nemanich, P. Holloway, T. Trottier, W. Mackie, D. Temple, J. Itoh (Materials Research Society Symposium Proceedings, Vol. 621, 2001).

6. Review Chapters

1. "Schottky Barriers on Amorphous Si and Their Applications," R.J. Nemanich and M.J. Thompson, Metal-Semiconductor Schottky Barrier Junctions and Their Applications edited by B.L. Sharma, (Plenum Publishing Corp., 1984).

2. "Schottky Barriers on a-Si:H," R.J. Nemanich, Semiconductors and Semimetals, Vol. 21, Part C, Edited by J. Pankove, (Academic Press, 1984).

3. "Surface Characterization," Analytical Chemistry Application Reviews 61, 243R-269R (1989). J.E. Fulghum, G.E. McGuire, I.H. Musselman, R.J. Nemanich, J.M. White, D.R. Chopra, and A.R. Chourasia.

4. "Growth and Characterization of Diamond Thin Films," R.J. Nemanich. Annu. Rev. Mat. Sci., vol 21, 535-558 (1991).

5. "Surface Characterization," Analytical Chemistry Application Reviews 63, 99R (1991). M.A. Ray, G.E. McGuire, I.H. Musselman, R.J. Nemanich, and D.R. Chopra.

6. "Remote Plasma Processing for Silicon Wafer Cleaning," R.A. Rudder, R.E. Thomas, and R.J. Nemanich. Handbook of Silicon Wafer Cleaning Technology, Edited by W. Kern, (Noyce Publications, Park Ridge, NJ), p. 340-372, 1993,

7. "Characterization of the Composition, Stoichiometry and Related Microstructure of Optical Materials," R. J. Nemanich and T. P. Humphreys. Characterization of Optical Materials, Edited by Gregory J. Exarhos (Butterworth-Heinemann, Boston, 1993) p. 49-70.

8. "Surface Characterization," G. E. McGuire, M. A. Ray, Steven J. Simko, F. Keith Perkins, Susan L. Brandon, Elizabeth A. Dobisz, R. J. Nemanich, A. R. Chourasia and D. R. Chopra, Anal. Chem. Appl. Rev. 65, 311R-333R (1993).

9. "Surface Characterization," G. E. McGuire, Max L. Swanson, Nalin R. Parikh, Steve Simko, P. S. Weiss, J. H. Ferris, R. J. Nemanich, D. R. Chopra, and A. R. Chourasia, Anal. Chem. Appl. Rev. 67, 199R-220R (1995).

10. "Optical Properties of Diamond Films and Particles," Leah Bergman and R. J. Nemanich. *Handbook of Optical Properties Volume II*, edited by R. E. Hummel, P. Wissmann 331-371 (CRC Press, 1996).

11. "Raman Spectroscopy for Characterization of Hard, Wide Band Gap Semiconductors: Diamond, GaN, GaAlN, AlN, BN," Leah Bergman and Robert J. Nemanich. Annual. Review of Mater. Sci., Vol. 26, 551-579 (1996).

12. "Surface Characterization", G. E. McGuire, P. S. Weiss, J. G. Kushmerick, J. A. Johnson, Steve J. Simko, R. J. Nemanich, Nalin R. Parikh, and D. R. Chopra, *Anal. Chem*. **69**, 231R-250R (1997).

13. "Electron Emission from CVD-Diamond Cold Cathodes," Peter K. Baumann and Robert J. Nemanich, *Low -Pressure Synthetic Diamond, Manufacturing and Applications,* edited by B. Dischler and C. Wild , Chapter 15, p 281-303 (1998).

14. "Electron Emission from Diamond and Other Wide Bandgap Semiconductors," R. J. Nemanich, P. K. Baumann, M. C. Benjamin, S. P. Bozeman and B. L. Ward. Proceedings of the International School of Physics Enrico Fermi, *The Physics of Diamonds*, edited by A. Paoletti and A. Tucciarone, Varenna, Italy, p. 537-554, 1997.

15. "Electron Affinity of AlN, GaN and AlGaN Alloys," Robert J. Nemanich.*Gallium Nitride and Related Compounds*, Edited by Edgar, Strite, Akasaki and Amano, EMIS Datareview Series No. 23, (INSPEC, London, 1998), p. 98-103.

16. "Band offsets at inerfaces between AlN, GaN and InN," S. W. King, R. J. Nemanich and R. F. Davis. *Gallium Nitride and Related Compounds*, Edited by Edgar, Strite, Akasaki and Amano, EMIS Datareview Series No. 23, (INSPEC, London, 1998), p 500-505.

17. "Surface Characterization," G. E. McGuire, J. Fuchs, P. Han, J.G. Kushmerick, P.S. Weiss, S.J. Simko, R.J. Nemanich, and D.R. Chopra, *Anal. Chem*. 71, (12) 373R-388R (1999).

18. "Wet chemical cleaning and surface preparation of Si," M. M. Heyns and R. J. Nemanich. *Properties of Crystalline Silicon*, Edited by Robert Hull EMIS Datareview Series No 20, (INSPEC, London, 1999), p 219-225.

19. "HF vapour cleaning of oxide on c-Si," R. J. Carter and R. J Nemanich. *Properties of Crystalline Silicon*, Edited by Robert Hull EMIS Datareview Series No 20, (INSPEC, London, 1999), p. 226-234.

20. "Plasma and other in situ approaches to cleaning of c-Si surfaces," Hong Ying, R. J. Carter, G. B. Rayner and R. J. Nemanich. *Properties of Crystalline Silicon*, Edited by Robert Hull EMIS Datareview Series No 20, (INSPEC, London, 1999), p. 235-242.

21 "Principles of metal-semiconductor contacts and experimental studies of Ohmic Contacts to GaN," P. J. Hartlieb, R. F. Davis and R. J. Nemanich, *Nitride Semiconductors and Devices*, Edited by H. Morkoc, (Springer, New York, 1999) p. 191-215.

22. "Raman Scattering Spectroscopy and Analyses of III-V Nitride-Based Materials," Leah Bergman, Mitra Dutta and Robert J. Nemanich. *Raman Scattering in Materials Science*, Edited by W. H. Weber and R. Merlin. Springer, 273-313 (2000).

23. "Silicide Contacts for Si/Ge Devices," Chapter 7, J.E. Burnette, M. Himmerlich, R.J. Nemanich, *Silicide Technology for Integrated Circuits*, Edited by L.J. Chen, (IEE, London, 2004) p. 175-200.

24. "Raman spectroscopy of diamond and doped diamond" S. Prawer, R.J. Nemanich, Philosophical Translations of the Royal Society A 362, 2537-2565 (2004)

7. Publications

1975

1. "Coordination Dependent Vibrational Properties of Amorphous Semiconductor Alloys," G. Lucovsky, R.J. Nemanich, S.A. Solin, and R.C. Keezer. Solid State Commun. **17**, 1567-1572 (1975).

2. "Vibrational Modes of Amorphous $(GeS_2)_{1-x}(As_2S_3)_x$ and $(GeSe_2)_{1-x}(As_2Se_3)_x$," R.J. Nemanich, S.A. Solin and G. Lucovsky. Proc. of the 4th International Conference on Light Scattering in Solids, Campinas, Brazil (1975).

3. "Raman Spectra of the As_2S_3-GeS_2 and As_2Se_3-$GeSe_2$ Alloy Systems," R.J. Nemanich and S.A. Solin and G. Lucovsky. Proc. of the 6th International Conference on Amorphous and Liquid Semiconductors, Edited by B.T. Kolomiets, Leningrad, Russia (1975) p. 518-520.

1976

4. "Inexpensive High-speed Dentist Drill Light Chopper and its use in Rejecting Luminescence Background from Raman Spectra," R.J. Nemanich, S.A. Solin and J. Doehler. Rev. Sci. Instrum. **47**, 741-744 (1976).

1977

5. "Mossbauer Study of the Ferromagnetic Behavior of Chromium-rich Fe-Cr Alloys," R. Nemanich, C.W. Kimball, B.D. Dunlap and A.T. Aldred. Phys. Rev. **B 16**, 124-127 (1977).

6. "First Evidence for Vibrational Excitations of Large Atomic Clusters in Amorphous Semiconductors," R.J. Nemanich, S.A. Solin and G. Lucovsky. Solid State Commun. **21**, 273-276 (1977).

7. "Raman-Brillouin Light Scattering Determination of the Structural Correlation Range in $GeSe_2$ Glass," R.J. Nemanich, M. Gorman and S.A. Solin. Solid State Commun. **21**, 277-280 (1977).

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445. “NICE: an instrument for direct mass spectrometric measurement of interstellar neutral gas,” M. Wieser, P. Wurz, P. Bochsler, E. Moebius, J. Quinn, S. A. Fuselier, A. Ghielmetti, J. N. DeFazio, T. M. Stephen, R. J. Nemanich. Measurement Science & Technology 16 (8): 1667-1676 AUG (2005).

446. “Conduction band-edge d-states in high-k dielectrics due to Jahn–Teller term splittings,” G. Lucovsky, C.C. Fulton, Y. Zhang, J. Luning, L. Edge, J.L. Whitten, R.J. Nemanich, D.G. Schlom, V.V. Afanase'v. Thin Solid Films Volume 486, Issues 1-2, 129-135 August 22 (2005).

447. “Thermionic field emission from nanocrystalline diamond-coated silicon tip arrays,” J. M. Garguilo, F. A. M. Koeck, R. J. Nemanich, X. C. Xiao, J. A. Carlisle, O. Auciello. Physical Review B 72 (16): Art. No. 165404 OCT (2005).

448. “Sulfur doped nanocrystalline diamond films as field enhancement based thermionic emitters and their role in energy conversion,” F.A.M. Koeck, R.J. Nemanich, Diamond and Related Materials 14 (11-12): 2051-2054, (2005).

449. “Thermal stability of TiO2, ZrO2, or HfO2 on Si,,(100) by photoelectron emission microscopy,” M. C. Zeman, C. C. Fulton, G. Lucovsky, and R. J. Nemanich, W.-C. Yang. Journal Of Applied Physics 99, 023519 (2006).

450. “Emission characterization from nitrogen-doped diamond with respect to energy conversion,” F. A. M. Koeck , R. J. Nemanich. Diamond & Related Materials 15 (2-3): 217-220 (2006).

451. “Electronic properties of the Zr-ZrO2-SiO2-Si(100) gate stack structure,” C. C. Fulton, G. Lucovsky, R. J. Nemanich. Journal Of Applied Physics 99 (6): Art. No. 063708 (2006).

452. “Photoionization Thresholds of Melanins Obtained from Free Electron Laser–Photoelectron Emission Microscopy, Femtosecond Transient Absorption Spectroscopy and Electron Paramagnetic Resonance Measurements of Oxygen Photoconsumption,” T. Ye, L. Hong, J. Garguilo, A. Pawlak, G. S. Edwards, R. J. Nemanich, T. Sarna, J. D. Simon. Photochemistry and Photobiology, 82: 733–737, (2006).

453. “Thermal stability of TiO_2, ZrO_2, or HfO_2 on Si(100) by photoelectron emission microscopy,” M. C. Zeman, C. C. Fulton, G. Lucovsky, and R. J. Nemanich, W.-C. Yang. Journal Of Applied Physics 99, 023519 (May 2006). Art. No. 109902

454. “Photo and field electron emission microscopy, from sulfur doped nanocrystalline diamond films,” F.A.M. Koeck, M. Zumer, V. Nemanic, R.J. Nemanich, Diamond & Related Materials 15 (2006) 880–883

455. “The effect of Schottky barrier lowering and nonplanar emitter geometry on the performance of a thermionic energy converter, J.R. Smith, R.J. Nemanich, G.L. Bilbro, “Diamond and Related Materials 15, Issues 4-8 , April-August 870-874 (2006).

456. “Electron emission microscopy of nano-crystal graphitic films as high current density electron sources,” FAM Koeck, AN Obraztsov, RJ Nemanich, Diamond and Related Materials 15, Issues 4-8, April-August 875-879 (2006).

457. “Localized emission from flat diamond cathodes,” Griff L. Bilbro, Robert Nemanich Diamond & Related Materials 15 1418 – 1423 (2006).

458. “The surface oxidation potential of human neuromelanin reveals a spherical architecture with a pheomelanin core and a eumelanin surface”, William D. Bush, Jacob Garguilo, Fabio A. Zucca, Alberto Albertini, Luigi Zecca, Glenn S. Edwards, Robert J. Nemanich, and John D. Simon. Proceedings Of The National Academy Of Sciences Of The United States Of America 103 (40): 14785-14789 OCT 3 2006

459. “Fabrication of metallic nanowires on a ferroelectric template via photochemical reaction”, J. N. Hanson, B. J. Rodriguez, R.J. Nemanich, A. Gruverman. Nanotechnology 17 (19): 4946-4949 (OCT 14 2006)

8. Invited Conference Presentations

1. "Low Frequency Light Scattering from the Cuprous Halides," International Conference on Fast Ion Transport in Solids, Lake Geneva, Wisconson , 1979.

2. "Reactions at the Metal-Si Interface Studied by Interference Enhanced Raman Scattering," March Meeting of the APS, Los Angeles, 1981.

3. "Interference Enhanced Raman Scattering from Metal/Semiconductor Interfaces," Ninth International Conference on Raman Spectroscopy, Tokyo, Japan, 1984.

4. "Silicide Formation at Thin Film Interfaces," Third International Conference on Solid Films and Surfaces, Sydney, Australia, 1984.

5. "Raman Spectroscopy for Semiconductor Thin Film Analysis," Spring Meeting of the Materials Research Society, Palo Alto, CA, 1986.

6. "The Initial Stages of Silicide Epitaxy - Nucleation and Morphology," Spring Meeting of the Materials Research Society, Palo Alto, CA, 1987.

7. "Characterization of Diamond Films by Raman Spectroscopy," Stanford University Short Course on Diamond Films, Stanford, CA, 1989.

8. "Characterization of Growth Processes of Diamond Thin Films by Raman Spectroscopy," U.S. ARO Workshop - Army Applications for Diamond and Diamondlike Materials, Chapel Hill, NC, 1989.

9. "Characterization of Growth Processes of Diamond Thin Films by Raman Spectroscopy," Penn. State AVS-MRS symposium on Preparation and Characterization of Diamond and Diamond-like Materials, University Park, PA, 1989.

10. "Interference Enhanced Raman Scattering from Thin Films and Interfaces," Microbeam Analysis Symposium, Asheville, NC, 1989.

11. "Diamond Characterization - Bulk properties," UC Berkeley Extension Short Course - "Diamond Thin Films: Synthesis and Applications," San Francisco, 1990.

12. "Characterization of Growth Processes of Diamond Thin Films by Raman Spectroscopy," TMS Meeting, Anaheim, California, 1990.

13. "Use of Raman Scattering for Temperature Measurement of Silicon," Semiconductor Research Corporation Topical Research Workshop on Temperature Measurements, Santa Fe, New Mexico, 1990.

14. "Raman Characterization of Diamond Film Growth," Second International Conference on the New Diamond Science and Technology, Washington, DC, 1990.

15. "Characterization of Diamond Films," Short Course Materials Research Society Symposium, Anaheim, California, Spring 1991.

16. "Cleaning and Passivation of Si Surfaces for Semiconductor Thin Film Growth or Processing," Gordon Research Conference, Plymouth, New Hampshire, 1991.

17. "Raman Characterization of Thin Diamond Films," International Conference of Physics Students, Vienna, Austria, 1991 (presented by Eugen Buehler).

18. "Nucleation and Morphology of TiSi2 on Si," Materials Research Society Symposium, San Francisco, California, April, 1992.

19. "Properties of Interfaces of Diamond," Trieste Semiconductor Symposium on Wide-Band-Gap Semiconductors, Trieste, Italy, July, 1992.

20. "Interface Structure of Epitaxial $TiSi_2$ on Si(111)," 50th Annual Electron Microscopy Society of America meeting, Boston, August, 1992.

21. "Plasma Surface Interactions and Surface Properties of Remote Plasma Cleaned Si(100)," Seoul, Korea, Korea Technical Symposium, November 1992.

22. "Metal/Diamond Interfaces: Negative Electron Affinity Effects," American Physical Society, Seattle, March, 1993.

23. "Plasma-surface interactions and surface properties for remote plasma cleaning of Si(100)," Materials Research Society Symposium Y, San Francisco, CA, April 13, 1993.

24. "Stacked gate MOSFET with raised source-drain configuration using single wafer cluster technology," Santa Clara Plastics' 1st Annual Symposium, Boise, Idaho, October 7-8, 1993.

25. "Disordered Structures in CVD Diamond Films," Symposium on Amorphous Insulators, Winter Park, Colorado, August 7-11, 1994.

26. "Characterization of Semiconductors with a UV Photoemission Electron Microscope," Materials Characterization with IR, VUV and Soft X-ray Microscopy, Duke Free Electron Laser Laboratory, March 17, 1995.

27. "Hydrogen Plasma Cleaning," Presented to the Clean Wafer Club, June 1995.

28. "Diamond Negative Electron Affinity Surfaces, Structures and Devices," 3rd International Conference on the Applications of Diamond Films and Related Materials, NIST, Gaithersburg, MD, August 21-24, 1995.

29. "Negative Electron Affinity Surfaces of AlN and Diamond," Diamond Films '95, Barcelona, Spain, September 10-15, 1995.

30. "(Negative) Electron Affinity of AlN and AlGaN Alloys," Material Research Society, Symposium AAA, Boston, MA, Fall 1995.

31. "Ohmic Contacts in Si-Ge Alloys," Annual TMS Meeting, Los Angeles, CA, February 6, 1996

32. "Electron Emission from Diamond and Other Wide Bandgap Semiconductors," University of Twente, Amsterdam, Holland, February 20-25, 1996.

33. "Electron Emission from Diamond and Other Wide Bandgap Semiconductors," International School of Physics Enrico Fermi, Varenna, Italy, July 29-Augurst 2, 1996.

34. "Electron Emission From Diamond and other Wide bandgap Semiconductors," Frontier Carbon Technology Symposium in Tsukuba, Japan.October 18-26, 1996.

35. "Electron Emission from Diamond Films and Surfaces," International Union of Materials Research Societies-ICA'97, Symposium I, Super Carbon, Tokyo, Japan, September 16-19, 1997.

36. "Electron Emission Properties of Diamond and Nitride Surfaces," The Fourth International Symposium on Atomically Controlled Surfaces and Interfaces, Waseda University, Tokyo, Japan, October 27-30, 1997

37. "Free electron laser and Photo Emission Electron Microscope (PEEM) in Materials Research," Materials Research Society, NC Section Annual Symposium, Microelectronics Center of North Carolina, November 20, 1997.

38. "Formation and Characterization of Nanoscale Epitaxial Islands on Silicon," Materials Research Society symposium *Surface-Controlled Nanoscale Materials for High-Added-Value Applications*, Boston, Dec. 1997.

39. "Characterization of Electron Emitting Surfaces of Diamond and III-V Nitrides," Second International Symposium on Diamond Electronic Devices, Osaka, Japan, March 9-10, 1998.

40. "Photo-Electron Emission Microscopy of Semiconductor Surfaces," FEL Workshop at Vanderbilt University, Nashville, TN. March 23-24, 1998.

41. "Electron Emission Properties of Crystaline Diamond and Nitride Surfaces," Materials Research Society, symposium *Materials Issues in Vacuum Microelectronics*, San Francisco, April, 1998.

42. "Remote Plasma and HF Vapor Phase Approaches for In Situ Cleaning," SCP International Symposium on Wafer Surface Conditioning, Boise, ID. April 23-24, 1998.

43. "Electron Emission from Crystalline Diamond Surfaces," R. J. Nemanich, P. K.Baumann, A. T. Sowers and B. L. Ward. 8th CIMTEC Conference.Florence, Italy. June 13-17, 1998.

44. "Imaging Electron Emission from Diamond and III-V Nitrides with Photo-electron Emission Microscopy," R. J. Nemanich, S. L. English, J. D. Hartman, A. T. Sowers, B. L. Ward, H. Ade, and R. F. Davis. Presented at 2nd International Vacuum Electron Sources Conference, Ibaraki, Japan, July 3-12, 1998.

45. "Photo-Electron Emission Microscopy of Semiconductor Surfaces," R. J. Nemanich. S. L. English, J. D. Hartman, W. Yang, H. Ade, and R. F. Davis, Microscopy and Microanalysis '98 Meeting, Atlanta, GA, July 12-17, 1998.

46. "Surfaces and Interfaces of Diamond and Other Wide Bandgap Materials," R. J. Nemanich, P. K. Baumann, S. L. English, A. T. Sowers, B. L. Ward, J. van der Weide, H. Ade and R. F. Davis. IVMEC-E- Emission Meeting, July 23-25, 1998, Asheville, NC.

47. "Instabilities of Interfaces of SiGe Alloys," Robert J. Nemanich, David Aldrich, Boyan Boyanov, Peter Goeller and Dale E. Sayers. 4th International Conference on Electronic Materials, Plenary Session II, Korea, August 23-29, 1998.

48. "Correlation of Electron Affinity and Electron Emission of Diamond," R. J. Nemanich, P. K. Baumann, S. English, A. T. Sowers and B. L. Ward. Sixth International Conference on New Diamond Science and Technology, Johannesburgh, South Africa, August 30-September 4, 1998.

49. "UV-FEL PEEM Studies of Dynamical Properties of Surfaces," R. J. Nemanich. SURA Workshop on UV, X-Ray and Gamma Ray Applications of FELs, Washington, DC, November 20, 1998.

50. "Electron Emission from Nitrogen doped CVD Diamond films," A. T. Sowers, B. L. Ward and R. J. Nemanich. WE-Heraeus Seminar, Technische Universitat at Ilmenau, Germany. May 1999.

51. "Electron Emission and PEEM of Nitrogen Doped Diamond Films," 5th International Conference on Advanced Materials, Beijing, China, June 13-18, 1999.

52. "Variable Wavelength PEEM of N and B Doped Diamond Films," Applied Diamond Conference/Frontier Carbon Technology, Tsukuba, Japan. August 31-September 3, 1999.

53. "Photoemission microscopy studies of electron emission and electron affinity of diamond," R. J. Nemanich, S. L. English, F. A. M. Koeck, A. T. Sowers and H. Ade. 10th Eurpoean Conference on Diamond, Diamond-Like Materials, Carbon, Nanotubes, Nitrides and Silicon Carbide, Prague, Czech Republic, September 12-17, 1999.

54. "Correlation of PEEM and Field Emission of CVD Diamond," R. J. Nemanich, D. Alexson, A. T. Sowers and B. L. Ward. 196th Electrochemical Society Conference, Honolulu, Hawaii, October 17-22, 1999.

55. "Integrated HF Vapor Phase Cleaning and Surface Preparation for Gate Dielectrics," R. J. Nemanich, 2nd Annual International SEMATECH Wafer Cleaning and Surface Preparation Workshop, 2000. April 11-12, 2000.

56. "Prospects for Diamond/Carbon based Micro and Nano Structures," Plenary talk at First FCT Symposium, Tokyo, Japan, June 4-8, 2000.

57. "Imaging Electron Emission from Diamond Film Surfaces: N-doped Diamond vs. Nanostructured Diamond," R.J. Nemanich, F.A.M. Köck, and J.M. Garguilo, 7th International Conference on New Diamond Science and Technology, (ICNDST-7) City University of Hong Kong, July 24-28, 2000.

58. "UV Photo-Electron Emission Microscopy of the Dynamics of Nanostructures on Silicon Surfaces," R. J. Nemanich, Woochul Yang and Harald Ade. 22nd International Free Electron Laser Conference and 7th FEL Users Workshop, Duke University, Durham, NC August 13-18, 2000.

59. "Electron Emission from Wide Bandgap Semiconductors: Issues of Spatial Uniformity," R. J. Nemanich, F. Kock, J. Garguilo, and G. Bilbro, First International Symposium on Cold Cathodes, 198 th Meeting of the Electrochemical Society, Phoenix, AZ, October 25-27, 2000.

60. "UV-FEL photo-electron emission microscopy of nanostructures on silicon surfaces," R. J. Nemanich, W. Yang, and H. Ade, Photonics West, LASE, San Jose, CA, January 20-26, 2001.

61. "Temperature dependence of electron emission from diamond/carbon films," R. J. Nemanich, F. A. M. Koeck and J. M. Garguilo. The International Topical Meeting on Field Electron Emission from Carbon Materials, Moscow, Russia, July 2-4, 2001.

62. "N-Doped CVD Diamond Films as a Low Temperature Thermionic Field Electron Source," Sixth Applied Diamond Conference/Second Frontier Carbon Technology Joint Conference, (ADC/FCT), Auburn, Alabama, Aug. 4-10, 2001.

63. "Electron Emission from Carbon Materials," LXXXVII Annual Meeting of SIF (Italian Physical Society), University Milano-La Bicocca, Milan, Italy, Sept. 22-27, 2001.

64. "Diamond Field Emission Devices for Displays and Microsystems," Robert J. Nemanich, March Meeting 2002 American Physical Society, Indianapolis, IN, March 18-22, 2002.

65. "Spatial and temperature dependence of electron emission from nanocrystalline diamond films," R.J. Nemanich, J.M. Garguilo, F.A.M. Kock. CIMTEC International Conferences on Modern Materials & Technologies. 3rd International Conference, Diamond and Other Carbon Materials. Florence, Italy, July 14-18, 2002.

66. "Future research needs for carbon based materials," R.J. Nemanich. CIMTEC International Conferences on Modern Materials & Technologies. 3rd International Conference, Diamond and Other Carbon Materials. Florence, Italy, July 14-18, 2002.

67. "Piezoresponse Force Microscopy for Piezoelectric Measurements and Polarity Imaging of III-Nitride Materials," R.J. Nemanich, B.J. Rodriguez, A. Gruverman, A.I. Kingon,. International Workshop on Bulk Nitride Semiconductors, Ariau Lodge, Amazonas, Brazil, May 18-23, 2002.

68. "Raman Investigation on Inversion Domains in GaN." M. Park, J. J. Cuomo, W.-C. Yang, B. J. Rodriguez, R. J. Nemanich, O. Ambacher, Joint Meeting, the Materials Research Society (MRS)-North Carolina Section and the Mid-Atlantic Chapter of the American Vacuum Society (AVS), Chapel Hill, North Carolina, U. S. A., Nov. 15, 2002.

69. "Piezoresponse Force Microscopy and Photo Electron Emission Microscopy of GaN Lateral Polarity Heterostructures," R.J. Nemanich, B.J. Rodriguez, W-C. Yang, M. Par, A. Gruverman, A.I. Kingon, ONR Workshop on Defect Characterization Techniques in Wide Gap Semiconductors, Maui, Hawaii, March 16-20, 2003.

70. "Processing-induced changes in GaN/insulator interface electronic states," Robert Nemanich, Tri-Services Workshop on Process Induced Defects in Wide Bandgap Semiconductors, ONR, Grants Pass, OR, Aug. 17-21, 2003.

71. "Dynamics of Nano Wire Formation on Si(100) Surfaces," R.J. Nemanich, Lena Fitting, A. Sunda-Meya,M.C. Zeman, W-C Yang, IUMRS-ICAM 2003, Yokohama, Japan, Oct. 8-13, 2003.

72. "Approaches for Involving Materials Researchers in Education Outreach Programs," Robert Nemanich, IUMRS-ICAM 2003, Yokohama, Japan, Oct. 8-13, 2003.

73. "Trends in Surface and Interface Electronic Properties of III-Nitride Materials," R.J. Nemanich, 2nd Brazil-MRS Meeting, Rio de Janeiro, Brazil, Oct. 26-29, 2003.

74. "Perspectives on International Collaboration from the International Union of Materials Research Societies – IUMRS," Robert Nemanich, 2nd Brazil-MRS Meeting, Rio de Janeiro, Oct. 26-29, 2003.

75. "Welcome presentation," Words by co-organizers and sponsors, Robert Nemanich, 2nd Brazil-MRS Meeting, Rio de Janeiro, Oct. 26-29, 2003.

76. "Structural Challenges for Materials 'Research and Materials' Technologies: View from the United States and from Other Countries of the Americas," R. Nemanich, Workshop Scientific and Technological Development in the Americas, Quito, Ecuador, Dec. 10-12, 2003.

77. "Cross-Hatch morphology, misfit dislocation, and strain relaxation in SiGe epitaxy on high-index Si surfaces", R.J. Nemanich, M.E. Ware, L. Fitting 2004 U.S. Workshop on the Physics and Chemistry of II-VI Materials Oct. 5-7, 2004 Chicago, Il

78. "Imaging Nanostructures in Motion," R.J. Nemanich. Nanoscience in the 21st Century, Oct. 15-16, Fall Meeting of the Illinois Section of the American Association of Physics Teachers, 2004 Peoria, Il.

79. "Influence of strain, surface diffusion and ostwald ripening on the evolution of nanostructures on Si surfaces," R.J. Nemanich, W.L. Yang, L. Fitting, M.C. Zeman, 3rd Brazil MRS Meeting, Oct. 10-13, 2004, Iquassu Falls, Brazil.

80. "Passivation and Processing-Induced Changes in GaN/Insulator Interfaces," RJ Nemanich, T.E. Cook, Jr. C.C. Fulton, W.J. Mecouch, R.F. Davis, G. Lucovsky, AVS 51st International Symposium & Exhibition Nov. 14 – 19, 2004 Anaheim, CA

81. "The Potential of Carbon Based Materials in Vacuum Thermionic Energy Conversion," F.A. Koeck, J.R. Smith, J. Garguilo, Y. Wang, S. Gupta, G. Bilbro, R.J. Nemanich. 2005 Spring Meeting MRS, March 28 – April 1, 2005, San Francisco, CA.

82. Plenary sessions: Advanced Materials Panelists. International conference on materials research and education: Future trends and Opportunities Doha, Qatar April 2005.

83. "The Potential of Diamond Materials in Vacuum Thermionic Energy Converstion," Franz A. M. Koeck, Yingjie Tang, Joshua Smith, Griff L. Bilbro, and Robert J. Nemanich. The 24th International Conference on Thermoelectrics, June 19-23, 2005, Clemson, SC.

84. "Photoelectric Effect," R.J. Nemanich. 100th Anniversary of Physics' Greatest Year, Einstein Centennial Series, Cox Hall, NCSU, Raleigh, NC March 21, 2005

85. "The Potential of Diamond Materials in Vacuum Thermionic Energy Converstion," R.J. Nemanich. ICT 2005 Clemson University, Clemson, SC June 19-23, 2005

86. "Thermionic and Field Electron Emission from Nanostructured Carbon Materials for Enegy Conversion and Vacuum Electronics," Franz Koeck, Yunyu Wang, Robert J. Nemanich. The 31st Annual Conference of the IEEE Industrial Electronics Society, Nov. 6-10, 2005, Sheraton Capitol Center, Raleigh, NC.

87. "Interface band alignment at High-k / Metal gate structures: Interface dipoles and internal fields," R. Nemanich. 36th IEEE Semiconductor interface specialists conference, Arlington, VA Dec. 2005.

88. International Union of Materials Research Societies 4th Forum on New Materials, Co-Chair and Steering Committee CIMTEC 2006, R. Nemanich, June 4 to 9, 2006, Acireale, Sicily, Italy.

9. Short Courses and Tutorials

"Characterization of Diamond Films," J.T. Glass and R.J. Nemanich, Short Course, Materials Research Society - Spring Meeting, Anaheim, 1991.

"Diamond Films: Growth and Properties," R.J. Nemanich, J.T. Glass, and J. Von Windheim, Short Course, Materials Research Society - Fall Meeting, Boston, 1992.

"Diamond Films: Growth and Properties," Linda S. Plano, David Dreifus, and R.J. Nemanich, Short Course, Materials Research Society - Spring Meeting, San Francisco, 1994.

"Electron Emission From Diamond," Michael Geis and Robert J. Nemanich, Tutorial, Materials Research Society - Fall Meeting, Boston, 1995.

"Electron Field Emitters Based on Carbon Materials," R.J. Nemanich, J.L. Davidson, W.P. Kang, Sixth Applied Diamond Conference/Second Frontier Carbon Technology Joint Conference, (ADC/FCT), Auburn, Alabama, Aug. 4-10, 2001.

10. Seminars and Colloquia (after 1986)

1. "Novel Liquid and Solid Phases of Laser Annealed Si," NCSU SPS Seminar (1986).

2. "The Initial Stages of Thin Film Epitaxy at Silicide/Si Interfaces," Princeton University, EE Department Seminar (1986).

3 "Scanning Tunneling Microscopy Applications to Heteroepitaxial Film Growth," UNC-Chapel Hill, Department of Physics Colloquium (1987).

4. "Silicide Formation on Crystalline and Amorphous Si," NCSU, Materials Science and Engineering Colloquium (1987). (Repeated on video tape as one of the years' five best)

5. "Initial Stages of Thin Film Epitaxy," University of Houston, Department of Physics Seminar (1988).

6. "Growth and Characterization of Diamond Thin Films," Xerox, PARC, Seminar (1988).

7. "Carbon Bonding in Diamond Thin Films," Wake Forest University, Department of Physics Colloquium (1988).

8. "Scanning Tunneling Microscopy - Nuts and Bolts and Applications," NCSU, SPS Seminar (1988).

9. "Silicides/Silicon Heteroepitaxy: Surface Preparation, Interface Structure, and Morphology," Battelle Pacific Northwest Laboratories, Seattle, Washington (1991).

10. "Interfaces on Diamonds," North Carolina State University, Department of Physics Colloquium (1991).

11. "Interfaces on Diamond: Negative Electron Affinity Affects," University of Virginia, Joint seminar of the Department of Physics and Department of Material Science (October 1992).

12. "Surface and Interface Morphologies of Epitaxial $TiSi_2$ and $ZrSi_2$ on Si," Hyandai, Seoul, Korea (November 19, 1992).

13. "Surface and Interface Morphologies of Epitaxial $TiSi_2$ and $ZrSi_2$ on Si," Korean Institute of Science and Technology (KIST), Seoul, Korea (November 20, 1992).

14. "Surface and Interface Morphologies of Epitaxial $TiSi_2$ and $ZrSi_2$ on Si," Samsung, Seoul, Korea (November 21, 1992).

15. "Metal/Diamond Interfaces: Negative-Electron-Affinity Effects," Materials Science and Engineering, N. C. State University, (April 2, 1993).

16. "Negative electron affinity affects on diamond," Department of Physics Solid State Seminar, UNC-Chapel Hill, January 18, 1994.

Lecture Series on Surfaces, Interfaces, and Thin Films: Presented at Wuppertal University, Department of Electrical Engineering, Center for Microstructures Research

17. "Surface Energy and Thin Film Nucleation (fundamentals)," May 26, 1994, Forschungszentrum fur Mikrostrukturtechnik, Wuppertal, Germany.

18. "Surface Reactions and H-Plasma Assisted Surface Phase Transformations," June 15, 1994, Forschungszentrum fur Mikrostrukturtechnik, Wuppertal, Germany.

19. "Diamond Film Growth and Characterization," June 17, 1994, Forschungszentrum fur Mikrostrukturtechnik, Wuppertal, Germany.

20. "Properties of Diamond Films and Surfaces," June 21, 1994, Forschungszentrum fur Mikrostrukturtechnik, Wuppertal, Germany.

21. "Raman Scattering for Semiconductor Thin Film Analysis," June 23, 1994, Forschungszentrum fur Mikrostrukturtechnik, Wuppertal, Germany.

22. "Negative Electron Affinity of Diamond Surfaces," June 20, 1994, Philips GmbH Research Laboratories Aachen, Germany.

23. "Negative Electron Affinity of Diamond Surfaces," June 27, 1994, Max Planck Institute for Semiconductor Research, Stuttgart, Germany.

24. "Wafer Cleaning for in situ Processing of Silicon," June 28, 1994 Institute for Semiconductor Research, Stuttgart, Germany.

25. "Negative Electron Affinity of Diamond and AlN," Dec. 15, 1994, NEC Research Institute, Princeton, NJ.

26. "Hydrogen Plasma Cleaning," R. J. Nemanich. Presented to the Clean Wafer Club, June 9, 1995

27. "Electron Emission From Wide Bandgap Semiconductors," Condensed Matter Seminar for the Department of Physics, University of North Carolina, Chapel Hill, NC January 17, 1996

30. "Electron Emission from Diamond and other Wide bandgap Semiconductors," Osaka University, Japan, October 1996.

31. "Surface and Interface Properties of SiGe Alloys," University of Virginia, Department of Physics Colloquium, November 11, 1996.

32. "Surface and Interface Properties of SiGe Alloys," University of Michigan, Department of Physics invited colloquium, January 30, 1997-February 1, 1997.

33. "Negative Electron Affinity Surfaces of Wide Bandgap Nitrides and Diamond," Ohio University, Department of Physics Colloquium, April 24-26, 1997.

34. "Photo-Electron Emission Microscopy of Semiconductor Surfaces," Vanderbilt University, Nashville, TN, March 23-24, 1998.

35. "Instabilities of Interfaces of SiGe Alloys," Robert J. Nemanich, David Aldrich, Boyan Boyanov, Peter Goeller and Dale E. Sayers. Samsung, Elect. Div., Korea, August 24, 1998.

36. "Instabilities of Interfaces of SiGe Alloys," Robert J. Nemanich, David Aldrich, Boyan Boyanov, Peter Goeller and Dale E. Sayers. Presented at Hanyang University Colloquium, Korea, August 28, 1998.

37. "Characterization of Electron Emitting Surfaces of Diamond and III-V Nitrides," R. J. Nemanich, P. K. Baumann, M. C. Benjamin, S. L. English, J. D. Hartman, A. T. Sowers and B. L. Ward. Presented at Samsung Adv. Mat. Division, Korea, August 28, 1998.

38. "Photo Electron Emission Microscopy (PEEM) of Semiconductor Surfaces using UV Free Electron Laser Excitation," Royal Institute of Techology, Stockholm, Sweden. May 24, 1999.

39. "Photo Electron Emission Microscopy (PEEM) of Semiconductor Surfaces using UV Free Electron Laser Excitation," University of Illinois, June 29-July 1, 1999.

40. "Electron Emission from Wide Bandgap Semiconductors: Issues of Spatial Uniformity," R. J. Nemanich, F. Koeck, J. Garguilo, and G. Bilbro, Argonne National Labs, Argonne, IL November 1, 2000.

41. "Electron Emission from Carbon Materials," Arizona State University, Department of Physics Colloquium, Nov. 15, 2001.

42. "Growth Dynamics of Silicide Nanostructures," R.J. Nemanich, Woochul Yang, Lena Fitting, seminar, Department of Materials Science and Engineering, Hanyang University, Seoul, South Korea, May 28, 2002.

43. "Growth Dynamics of Silicide Nanostructures," R.J. Nemanich, Woochul Yang, Lena Fitting, seminar, Samsung Electronics, Suwon, South Korea, May 28, 2002.

44. "Atomic Force Microscopy to Image Piezoresponse of III-Nitride Materials," Robert Nemanich and Brian Rodriguez, Texas Tech University, Lubbock, Texas, Oct. 3, 2002.

45. "Growth Dynamics of Silicide Nanostructures," R.J. Nemanich, Woochul Yang, Lena Fitting, Colloquium Department of Materials Science, Univ. of Wisconsin, Madison, WI, Oct. 10, 2002.

46. "Electron Emission from Nanostructured Carbon Materials," R. Nemanich, F.A.M. Koeck, J.M. Garguilo, First U.S. Armenian Workshop on New Electronic Materials, Ashtarak, Armenia, Nov. 3-10, 2002.

47. "Atomic Force Microscopy to Image Piezoresponse of III-Nitride Materials," Robert Nemanich and Brian Rodriguez, First U.S. Armenian Workshop on New Electronic Materials, Ashtarak, Armenia, Nov. 3-10, 2002.

44. "Growth Dynamics of Silicide Nanostructures," R.J. Nemanich, Woochul Yang, Lena Fitting, Jaehwan Oh, Matthew Zeman, Materials Colloquium, Case Western Reserve University, Jan. 28, 2003

11. Grants Awarded

1. "Complex Si Structures," Xerox Corp., 9/87, $20,000.

2. "Characterization of Epitaxial and Polycrystalline Silicide Formation," MCNC 87 Competitive Grants Program, 9/87 - 9/89, $20,000.

3. "Reactive Heteroepitaxial Film Growth - Nucleation and Morphology of Silicide-Si Interfaces," NSF, 3/88 - 2/92, $105,000 per year.

4. "Deposition of Semiconductor Films and Studies of Fundamental Electronic Processes in the Pico- and Femto-second Regime," (Joint program with Professor, H. Kurz, Technical University of Aachen), NC Board of Science and Technology, Lucovsky and Nemanich, 2/88 - 1/90, $25,000 per year.

5. "Center for Advanced Electronic Materials Processing," NSF Engineering Research Program; N. A. Masnari, Director; R. Nemanich - Coordinator of Wafer Cleaning Thrust Area; 9/88 - 9/99, $120,000 to 175,000 per year.

6. "Raman Characterization of Carbon Bonding in Diamond Thin Films," Research Triangle Institute, 1/1/89 - 12/31/90, $28,000 per year.

7. "Analysis of Complex Semiconductor Thin Film Structures," Research Triangle Institute, 8/15/88 - 8/31/90, $7,500 per year.

8. "Fundamental Studies of Defect Generation in Amorphous Silicon Alloys Grown by Remote Plasma-Enhanced Chemical-Vapor Deposition," SERI, Lucovsky, Nemanich and Bernholc, 7/89-12/91, $125,000 per year .

9. "Studies of Semiconducting Diamond Films: Synthesis and Characterization of Structural, Chemical and Electronic Properties," Japanese Ministry of International Trade and Industry (MITI), Jointly with NCSU, Kobe Steel Ltd., and Harwell Laboratory (England), PI - J. Glass, 8/89 - 8/92, $60,000 per year for NCSU.

10. "Optical Characterization of Diamond Films," Kobe Steel, 1/1/90-12/31/91, $25,000 per year.

11. "Static and Dynamic Properties of Semiconductor Microstructures," North Carolina Board of Science and Technology, R.J. Nemanich and G. Lucovsky, 1/1/90-6/30/91, $25,000 per year.

12. "Electronic Processes in the Femto- & Pico-Second Regime of N," North Carolina Board of Science and Technology, R.J. Nemanich and G. Lucovsky, 2/89-12/90, $25,000 per year.

13. “Raman Characterization of Carbon Bonding in Diamond Thin Films,” Kobe Development, R.J. Nemanich, 1/1/90-6/30/92, $25,000.00 per year.

14. “Characterization of Diamond Film Nucleation and Growth Surface,” Office of Naval Research, R.J. Nemanich, 4/1/90-10/31/91, $80,000.

15. “Growth Controlled Microstructures: Opto-Electronic Properties,” North Carolina Board of Science and Technology, R.J. Nemanich, 8/1/90-6/1/92, $25,000 per year.

16. “Atomic Scale Characterization of Thin Film Diamond Surface and Interface Properties,” The Office of Naval Research, R.J. Nemanich, 4/1/91-3/31/92, $50,000.

17. “Analysis of Complex Semiconductor Thin Film Structures,” Research Triangle Institute, 10/1/90 - 6/30/91, $7,500.

18. “Growth, Characterization, and Device Development in Monocrystalline Diamond Films,” Office of Naval Research, R.F. Davis and R.J. Nemanich, 2/1/91-11/30/91, $32,000.

19. “Analysis of Complex Semiconductor Thin Film Structures,” Research Triangle Institute, R.J. Nemanich and T.P. Humphreys, 8/15/91-8/31/92, $7,500.

20. “Interface Properties of Wide Bandgap Semiconductor Structures,” The Office of Naval Research - University Research Initiative, R.F. Davis and R.J. Nemanich, 1/1/92-12/31/96, $999,340 per year.

21. “Metal-Semiconductor Contacts to Diamond,” Kobe Development, T.P. Humphreys and R.J. Nemanich, 6/1/91-5/31/92, $30,000.

22. “Heteroepitaxial Silicide Formation on Silicon and SiGe Alloy Nucleation, Morphology and Stability,” National Science Foundation, R. J. Nemanich, $105,000 per year 7/1/92-6/30/95.

23. “Atomic Scale Characterization of Thin Film Diamond Surface and Interface Properties,” Office of Naval Research, through and in collaboration with the Research Triangle Institute, R. J. Nemanich, 1/1/92-12/31/94, $40,000 per year.

24. “Characterization of Diamond Films and Contacts,” Kobe Development, R. J. Nemanich and T. P. Humphreys, 4/1/92-3/31/93, $71,000.

25. “Raman Scattering Characterizations of Diamond Thin Films and Surfaces,” Research Triangle Institute, R. J. Nemanich, 11/19/91-7/14/92, $10,150.

26. “Low Temperature Deposition and Characterization of n- and p-Type Silicon Carbide Thin Films and Associated,” Office of Naval Research, R. J. Nemanich, 4/1/92-9/30/92, $24,906.

27. “Design of Prototype Chemical Vapor Deposition Reactor,” Battelle Pacific Northwest Laboratories, R.F. Davis and R. J. Nemanich, 3/23/93-12/28/94, $149,000.

28. “Particle Growth in Subatmospheric Pressure Processing Equipment,” Research Triangle Institute, R. Nemanich, (9/92-8/94, $22,000 per year).

29. “Measurement of Strain in 300-600 μm Single Crystal,” GE Superabrasive, R. J. Nemanich, 3/24/93-6/30/94, $40,000.

30. “Advanced Growth & Surface Analysis System for In-Situ Studies of Interface Information,” Department of Energy, D. E. Sayers and R. J. Nemanich (September 1993, $330,000.00).

31. “Diamond Based Cold Cathode Triodes/High Frequency and Power Application,” Diamond Microelectronics Corp., R. J. Nemanich, (January 1995, $234,137).

32. “A New Diamond Electron Emitter Device,” PTS Company (STTR Proposal to ONR), R. J. Nemanich, (January 1995, $40,000).

33. “Development of Cold Cathode Emitters Based on Diamond,” Office of Naval Research (ASSERT), R.F. Davis and R.J. Nemanich, (June 1995, $90,000).

34. “Photo-Electron Emission Microscopy Free Electron Laser System,” Office of Naval Research, R.J. Nemanich, R.F. Davis and H. Ade, (July 1995, $689,665).

35. “Defects and Impurities in 4H and 6H SiC Homoepitaxial Layers,” Office of Naval Research, R.F. Davis, J. Baliga, R. J. Nemanich, (July 1995-July 1998, $400,000 /yr).

36. “Phonons in Quantum Epitaxial Structures of Wide Bandgap Materials,” Army Research Office, (3/1/97-2/28/2000, $232,000)

37. “Interface Engineering and Defect Control in Heteroepitaxial Growth of GaN,” Office of Naval Research, R. Nemanich, R. Davis and H. Ade, (June 1997-June 1999, $250,000).

38. “Ultra-Violet Raman & Photoluminescence Spectroscopy for the Study of Wide Bandgap Semiconductors,” DURIP Army Research Office, R. Nemanich and L. Bergman (March 98-March 99, $112,500).

39. “Characterization of Electron Emission from Frontier Carbon Materials,” Japan Fine Ceramics Center, R.J. Nemanich and Z. Sitar (Dec 1998 – March 2002, $400,000).

40. “Compact Power Suplies Based on Heterojunction Switching in Wide Band Gap Semiconductors,” ONR MURI, R. Davis (PI) Wafer Bonding and Interfaces Project (Nemanich) (June 98- May 2003, ~$120,000 per yr).

41. "UV-FEL Studies of the Dynamics of Surface Processes and Film Growth," R. Nemanich (PI), H. Ade, and R. Davis (Subcontract through Duke Univ from AFOSR, Sept 2000 – August 2004, $105,000 per yr.).

42. "Dynamics of Interface Instabilities & Nanostructure Formation on Si & SiGe Alloys," NSF, R. J. Nemanich, $380,809. 4/1/2001 –3/31/2004

43. "Ohmic Contacts to Bulk N-Type Gallium Nitride," Kyma Technologies Inc., STTR-Phase I, BMDO, N, Oarjm R.J. Nemanich, J. Cuomo, $42,000. 11/26/2002 – 5/26/2003

44. "Characterization of Electron emission from Frontier Carbon Materials of Electron Emission," Japan Fine Ceramics Center - NEDO, R. J. Nemanich and Z. Sitar, $383,504.00. 12/18/1998 –3/31/2003

45. "Compact Power Supplies Based on Heterojunction Switching in Wide band gap Semiconductors," ONR, R. F. Davis, K. W. Kim, R. J. Nemanich, and Z. Sitar, $5,544,999. 4/01/1998 – 12/31/2003.

46. "Synthesis & Processing of Carbon-based Nanostructured Materials," Argonne Nat Lab, R.J. Nemanich, $84,000. 3/29/2002 – 3/28/2006

47. "Growth and Characterization of GaN, AlGaN Piezoelectronics and Electron Structure Emitting Computation of Para and Pie," University of California-San Diego, R. F. Davis, R. J. Nemanich and J. Bernholc, $625,000. 5/1/1999 – 11/29/2005

48. "Materials Processing & Characterization for a Novel High Current Switch," PTS Co., SBIR-Phase I, US Air Force, R.J. Nemanich, $20,000. 5/7/2002 – 5/6/2003

49. "Materials Processing and Characterization for a Novel High Current Switch, Phase II," Power Technology Services Co. (PTS), SBIR-Phase II, US Air Force, R. Nemanich, G. Bilbro, $312,785, 07/01/2003 - 06/30/2005.

50. "Indentation, Scribing and Machining of HPPT Material," Western Michigan University, National Science Foundation-FGR, R. Scattergood, R.J. Nemanich, $210,846, 08/01/2003 - 06/30/2005.

51. "Self Organized Epitaxial SiGe Multilayer Structures (The Center for Nanoscopic Materials Design)," University of Virginia, National Science Foundation-MRSEC, R. Nemanich, $50,000, 06/01/2004- 05/31/2005.

52. "Application of in-situ Spectroscopy Methods and ab initio Theory to Band Alignment and Thermal Stability at Metal-High k Gate Dielectric Interfaces," NCSU Center for Advanced Electronic Material Processing-NSF, Semiconductor Research Corp., R. Nemanich, $93,132, 04/01/2004- 03/31/2006.

53. “Carbon Nanostructures for Energy Conversion, Sensing, Electronics and Displays,” Vanderbilt University, US Army Research Laboratories, R. Nemanich (PI), Z. Sitar, C. Sagui, S. Franzen, K. Weninger, $3,715,000, 05/20/2004- 05/19/2008

54. “Acquisition of a Scanning Probe System for Characterization of Nanostructure Properties,” National Science Foundation , R. Nemanich, C. Gorman, H. Hallen, J. Krim, $450,000.00, 08/01/2003 - 07/31/2005

55. “Fabrication of GaN Schottky Diode Power Rectifier on Bulk GaN with Advanced Metal Contacts,” Kyma Technologies, Inc, SBIR-Phase II, US Dept. of Defense, R. Nemanich, J. Cuomo, $50,000, 10/01/2004- 09/30/2006.

56. “Interdisciplinary Doctoral Program in Electronic Materials,” US Dept. of Education, D. Larick, R. Nemanich, $931,104, 07/01/2005- 06/30/2008

57. “Carbon Nanostructures and Wide Bandgap Semiconductors for Vacuum Thermionic Energy Conversion,” University of California - San Cruz (Prime--US Navy), R. Nemanich, G. Bilbro, R. Davis, Z. Sitar, $1,170,000, 05/21/2003 through 11/30/2006.

58. “Thermionic Converters Based on Nanostructured Carbon Materials,” Power Technology Services Co. (PTS), SBIR Phase I, US Air Force, R. Nemanich, $33,295, 07/01/2003 - 06/30/2004.

59. “Materials Processing and Characterization for a Thermionic Converter Based on Nanostructured Carbon Materials,” Power Technology Services Co. (PTS), SBIR Phase II, US Air Force, R. Nemanich, G. Bilbro, $190,042, 03/25/2004 - 03/25/2006.

60. “NIRT: Configurable Nano Patterned Polar Surfaces for Molecular Pattern Formation and Transfer,” R. Nemanich (PI), C. Gorman, A. Kingon, M. Oliver-Hoyo, L. Clarke, T. Pearl, A. Grouverman, National Science Foundation-MRI, $1,600,000, 08/01/2004 - 07/31/2008.

61. “Multi-functional Extreme Environment Surfaces: Nanotribology for Air and Space,” US Air Force, J. Krim (PI), R. Nemanich, D. Brenner, A. Kingon, M. Zikry. $5,751,678.00, 05/01/2004- 04/30/2009

62. “Dynamics of Formation and Electronic Properties of Nanostructures on Silicon,” NSF, R. J. Nemanich, $255,000. 8/1/2005 –7/31/2008

63. “High Power Diamond Electronics,” Denso Corporation, R.J. Nemanich, $140,000, 10/01/07-09/09.

64. “Photo-stimulated nanopattern formation on polarity patterned ferroelectric surfaces,” NSF, R.J. Nemanich, $420,386, 07/01/2008-06/30/2011.