CURRICULUM VITAE
Dr. John Arthur Carlisle

PRESENT POSITION:

Physicist, Staff Scientist
Materials Science Division
Argonne National Laboratory
9700 South Cass Ave.
Argonne, IL 60439

Phone: (630) 252-3520
Fax: (630) 252-9550
Email: Carlisle@anl.gov
http://saturn.vcu.edu/~jacarlis

GENERAL RESEARCH INTERESTS:

Electronic structure and transport phenomena in dimensionally constrained materials. Synthesis and characterization of nanocrystalline diamond thin films using microwave plasma chemical vapor deposition and novel plasma chemistries. Synchrotron-radiation-based materials characterization using electron-yield and photon-yield techniques.

EDUCATION:

1988-1993 **Ph.D. (Physics), University of Illinois at Urbana-Champaign, Urbana, IL**
Thesis: "Geometric and electronic structure of reconstructed semiconductor surfaces" Advisor: Prof. T.-C. Chiang

1986-1988 **M.S. (Physics), Texas A&M University-Commerce, Commerce, TX**
Thesis: "XPS study of the CVD W/Si and W/$TiSi_2$ interfaces: interfacial fluorine"
Advisors: Prof. D.R. Chopra, Prof. T.R. Dillingham

1984-1986 **B.S. (with Highest Honors, with Academic Distinction), Physics & Mathematics, Texas A&M University-Commerce, Commerce, TX**
Honors Thesis: "The orthogonal transform and its application to speech compression and analysis"
Advisor: Prof. K.S. Min

EMPLOYMENT HISTORY:

8/00-present **Physicist, Staff Scientist, Materials Science Division, Argonne National Laboratory**. Electronic structure and transport phenomena of nanoengineered materials. Synthesis and characterization of nanocrystalline diamond and diamond-like thin films. Synchrotron-radiation-based characterization of nanostructured material systems.

8/96-7/00 **Assistant Professor of Physics, Department of Physics, Virginia Commonwealth University**. Synthesis of technologically-relevant surface, buried thin-film, and multilayer systems using molecular beam epitaxy, ion-beam sputtering, and gas-phase techniques, and their characterization using time-resolved reflection high-energy electron diffraction and various synchrotron-radiation-based techniques, including high-resolution photoemission, photoabsorption, and soft-x-ray fluorescence spectroscopies.

10/93-7/96 **Postdoctoral Research Associate, Department of Chemistry and Materials Science, Lawrence Livermore National Laboratory**. Characterization of novel surface, interfacial, and materials systems using synchrotron radiation based techniques at the Advanced Light Source (ALS) and the Stanford Synchrotron Radiation Center (SSRC). Techniques used included photoemission, photoelectron holography, photoabsorption, and soft x-ray fluorescence,

6/89-9/93 **Graduate Research Assistant, Department of Physics, University of Illinois at Urbana-Champaign**. Synthesis and characterization of clean and adsorbate-induced reconstructions of semiconductor surfaces. Techniques used included angle-integrated core-level and valence-band photoemission spectroscopy using synchrotron radiation, angle-resolved photoemission spectroscopy using synchrotron radiation, photoemission surface extended x-ray absorption fine structure, scanning-tunneling microscopy, Auger-electron spectroscopy, reflection high-energy electron diffraction, Ar-ion sputtering, Laue diffraction, and molecular-beam epitaxy.

8/88-5/89 **Teaching Assistant, Department of Physics, University of Illinois at Urbana-Champaign**. Conducted a laboratory in conjunction with an intermediate-level mechanics/E&M undergraduate course.

6/87-7/88 **Graduate Research Assistant, Department of Physics, Texas A&M University-Commerce**. Characterization of technologically relevant low-pressure chemical-vapor-deposited (LPCVD) tungsten/silicon and tungsten/silicide interfaces using x-ray photoemission spectroscopy, and depth-profiling using Ar-ion sputter-profiling.

8/86-5/87 **Teaching Assistant, Department of Physics, Texas A&M University-Commerce**. Responsible for all aspects of teaching a year of freshman level physics (lecture, problems session, laboratory).

8/84-5/86 **Research Assistant, Department of Physics, Texas A&M University-Commerce**. Worked on Honors thesis in a digital speech processing laboratory whose objective is to develop software and hardware to analyze and compress speech signals and to evaluate the performance of such algorithms via objective and subjective measures of speech quality.

AWARDS:

1993 National Research Council Postdoctoral Research Fellowship Award
1988 Outstanding Student Paper, American Vacuum Society meeting at Dallas
1986 Graduated with Academic Distinction, with Highest Honors
1986 Outstanding Senior Physics Major
1984 Odessa Cleavenger Mathematics Award
1982 CRC Freshman Chemistry Award

RESEARCH GRANTS

1. Development of Ultrananocrystalline Diamond (UNCD) Coatings for SiC Multipurpose Mechanical Pump Seals, DOE OIT, 01-07, $1,500,000
2. A high-density microelectronic tissue hybrid sensor for imaging, DOE Medical Sciences, 01-03, $600,000
3. Synthesis and Processing of Carbon-Based Nanostructured Materials, DOE SC MS, 01-03, $900,000
4. Electronic Structure of Intermetallics, Research & Development Center, Philip Morris USA, 00-01, $161,000
5. Investigation of Polarization Effects in Nitride Semiconductors and Heterointerfaces, National Science Foundation (Division of Materials Research), 99-01, $330,793
6. Nanostructured Materials and Nanotechnology across the Undergraduate Science and Engineering Curriculum, Camille & Henry Dreyfus Foundation, 99-00, $37,000
7. Acquisition of an X-ray Diffractometer for the Study of Thin Films and Nanostructured Materials, National Science Foundation (Major Research Instrumentation), 98-99, $170,000
8. Study of buried thin films using soft-x-ray fluorescence spectroscopy, Research Corporation Cottrell College Science Award, 98-99, $33,906.
9. Electronic Structure/Property Relationships in Deeply-Buried Thin-Films, Jeffress Memorial Trust, 97-98, $18,700.
10. Study of buried iron silicide thin films using soft-x-ray fluorescence spectroscopy, VCU Grant-in-Aid, 97, $5,000.

PROFESSIONAL MEMBERSHIPS:

American Physical Society
Materials Research Society
American Vacuum Society
American Association of Physics Teachers

PEER-REVIEWED PUBLICATIONS:

NUMBER OF PAPERS IN PEER-REVIEWED JOURNALS: 64

NOTE: Most of the publications listed below can be viewed at http://saturn.vcu.edu/~jacarlis/CV_frames.htm.

1. N. Moldovan, O. Auciello, **J. A. Carlisle**, R. Divan, D.M. Gruen, A. Jayatissa, A.R. Krauss, D. C. Mancini, A. Sumant, and J. Tucek, Micromachining of Ultrananocrystalline Diamond, SPIE conf. Proceedings (submitted).

2. S. Bhattacharyya, O. Auciello, J. Birrell, **J. A. Carlisle**, L. A. Curtiss, A. N. Goyette, D. M. Gruen, A. R. Krauss, J. Schlueter, A. Sumant, and P. Zapol, Synthesis and characterization of nitrogen doped ultrananocrystalline diamond thin films, Appl. Phys. Lett. (in press).

3. A.A. Baski, S.C. Erwin, M.S. Turner, K.M. Jones, J.W. Dickinson, and **J.A. Carlisle**, Morphology and electronic structure of the Ca/Si(111) system, Surf. Sci. 476, 22 (2001)

4. **J.A. Carlisle**, I.N. Germanenko, Y. Pithawalla, M.S. El-Shall, Morphology, photoluminescence and electronic structure in oxidized silicon nanoclusters, J. Electron Spectrosc. Relat. Phenon. 114-116, 229 (2001).

5. Eric L. Shirley, J.A. Soininen, G.P. Zhang, **J.A. Carlisle**, T.A. Callcott, D.L. Ederer, L.J. Terminello, R.C.C. Perera, Final-state electron interactions in inelastic x-ray scattering from solids: resonant and off-resonant**,** J. Electron. Spectrosc. Relat. Phenon. 114-116, 939 (2001)

6. **J.A. Carlisle**, M. Dongol, I.N. Germanenko, Y.B. Pithawalla, and M. Samy El-Shall, Evidence for changes in the electronic and photolumnescence properties of surface oxidized silicon nanocrystals induced by shrinking of the size of the silicon core, Chem. Phys. Lett. 326, 335 (2000).

7. I.N. Germanenko, M. Dongol, Y.B. Pithawalla, **J.A. Carlisle**, and M. Samy El-Shall, Effect of Atomospheric Oxidation on the electronic and photoluminescence properties of silicon nanocrystals**,** Pure Appl. Chem. 72, 245. (2000).

8. **J.A. Carlisle**, I.N. Germanenko, Y. Pithawalla, M. Dongol, and M.S. El-Shall, Morphology and electronic structure of oxidized silicon nanoclusters, in *Cluster and Nanostructure Interface*s, edited by P. Jena, S.N. Khanna, and B.K. Rao, p 397 (2000).

9. M.S. Turner, K.M. Jones, A.A. Baski, and **J.A. Carlisle**, Formation of 1D Ca Rows on Si(111), in *Cluster and Nanostructure Interface*s, edited by P. Jena, S.N. Khanna, and B.K. Rao, p 569 (2000).

10. Eric L. Shirley, **J.A. Carlisle**, S.R. Blankenship, R.N. Smith, L.J. Terminello, J.J. Jia, T.A. Callcott, and D.L. Ederer, *A band-structure-based approach to moldeling x-ray abosorption, fluorescence, and resonant inelastic scattering*, in AIP Conference Proceedings, Vol. 506, (X-ray and Inner-shell Processes, 18th. International Conference), edited by R.W. Dunford et al., pp. 283-303 (Amer. Inst. of Physics, Melville, NY, 2000).

11. **J.A. Carlisle**, S.R. Blankenship, R.N. Smith, A. Chaiken, R.P. Michel, T. Van Buuren, L.J. Terminello, J.J. Jia, T.A. Callcott, D.L. Ederer, *Electronic Structure and Crystalline Coherence in Fe/Si Multilayers*, J. Cluster Sci. 10, 591 (1999).

12. S.R. Blankenship, H. Song, A.A. Baski, and **J.A. Carlisle**, *Reconstructions of Ag on High-Index Silicon Surfaces*, J. Vac. Sci Tech. B **17**, 1615 (1999).

13. **J.A. Carlisle**, S.R. Blankenship, S.N. Smith, L.J. Terminello, T.A. Callcott, D.L. Ederer, *Soft-x-ray fluorescence studies of solids*, (Invited contribution to Vacuum Ultra-Violet conference), J. Electron. Spectrosc. Relat. Phenon. **103**, 839 (1999).

14. **J.A. Carlisle**, S.R. Blankenship, E.L. Shirley, L.J. Terminello, J.J. Jia, T.A. Callcott, D.L. Ederer, R.C.C. Perera, and F.J. Himpsel, *Crystal-momentum-resolved electronic structure of solids using resonant soft-x-ray fluorescence spectroscopy*, J. Electron. Spectrosc. Relat. Phenon.(in press).

15. **J.A. Carlisle**, E.L. Shirley, L.J. Terminello, J.J. Jia, T.A. Callcott, D.L. Ederer, R.C.C. Perera, and F.J. Himspel, *Band-structure and core-hole effects in resonant inelastic soft-x-ray scatting: Experiment and theory*, Phys. Rev. 59, 7433 (1999).

16. J. Jimenez-Mier, J. van Ek, D.L. Ederer, T.A. Callcott, J.J. Jia, **J.A. Carlisle**, L. Terminello, A. Asfaw, and R.C. Perera, *X-ray Raman and elastic scattering at the L-edge of titanium compounds: Experiment and theory*, Phys. Rev. B. **59**, 2649 (1999).

17. I. Jimenez, D.G.J. Sutherland, T. Van Buuren, **J.A. Carlisle**, L.J. Terminello, and F.J. Himpsel, *Photoemission and X-ray-absorption study of boron carbide and its surface thermal stability*, Phys. Rev. B **57**, 13167 (1998).

18. I. Jimenez, L.J. Terminello, D.G.J. Sutherland, **J.A. Carlisle**, E.L. Shirley, and F.J. Himpsel, *Accurate valence band width of diamond*, Phys. Rev. B **56**, 7215 (1997).

19. D.G.J. Sutherland, L.J. Terminello, **J.A. Carlisle**, I. Jimenez, F. J. Himpsel, K. M. Baines, D. K. Shuh, and W. M. Tong. *The chemisorption of $H_2C[Si(CH_3)(_3)]_2$ and $Si_6(CH_3)_{12}$ on Si(100) surfaces*, J. App. Phys. **82** 3567 (1997).

20. K. LawniczakJablonska, J.J. Jia, L. Lin, M.M. Grush, T.A. Callcott, D.L. Ederer, **J.A. Carlisle**, L.J. Terminello, and R.C.C. Perera, *Resonant inelastic scattering in dilute magnetic semiconductors by soft X-ray fluorescence spectroscopy*, App. Phys. A-Materials Science & Processing **65**, 173 (1997).

21. I. Jimenez, A.F. Jankowski, L.J. Terminello, D.G.J. Sutherland, **J.A. Carlisle**, G.L. Doll, W.M. Tong, D.K. Shuh, and F.J. Himpsel, *Core-level photoabsorption study of defects and metastable bonding configurations in boron nitride*, Phys. Rev. B **55**, 12025 (1997).

22. T. Van Buuren, L.N. Dinh, L.L. Chase, W.J. Siekhaus, I. Jimenez, L.J. Terminello, M. Grush, T.A. Callcott, and **J.A. Carlisle**, *Soft-x-ray emission studies of the electronic structure in silicon nanoclusters*, (Advances in Microcrystalline and Nanocrystalline Semiconductors - 1996. Symposium, Boston, MA, USA, 2-6 Dec. 1996). Edited by: Collins, R.W.; Fauchet, P.M.; Shimizu, I.; Vial, J.-C.; and others.Pittsburgh, PA, USA: Mater. Res. Soc, 1997. p. 171-5.

23. D.L Ederer, **J.A. Carlisle**, J. Jimenez, J.J. Jia, Ling Zhou, T.A. Callcott, R.C.C. Perera, A. Moewes, L.J. Terminello, E. Shirley, A. Asfaw, J. van Ek, and F.J. Himpsel, *Soft X-ray emission excited resonantly and nonresonantly by synchrotron radiation*, (X-Ray and Inner-Shell Process. 17th International Conference, Hamburg, Germany, 9-13 Sept. 1996). AIP Conference Proceedings, 1997 (no.389):749-70..

24. Nelson, AJ; Berry, G; Rockett, A; Shuh, DK; and **J. A. Carlisle**, *Observation of core-level binding energy shifts between (100) surface and bulk atoms of epitaxial $CuInSe_2$*, Appl. Phys. Lett **70** 1873 (1997).

25. Holloway, BC; Shuh, DK; Kelly, MA; Tong, W; **J.A.Carlisle**, I. Jimenez, D.G.J. Sutherland, and L.J. Terminello, *Synthesis and characterization of amorphous carbon nitride films*. Thin Solid Films **291**, 94 (1996).

26. I. Jimenez, A. Jankowski, L.J. Terminello, **J.A. Carlisle**, D.G.J. Sutherland, *Near-edge x-ray absorption fine structure study of bonding modifications in BN thin films by ion implantation*, App. Phys. Lett. **68**, 2816 (1996).

27. C.D. Zuiker, A.R. Krauss, D.M. Gruen, **J. A. Carlisle**, S.A. Asher, and R.W. Bormett, *Characterization of diamond films by core-level photoabsorption*, (Applications of Synchrotron Radiation Techniques to Materials Science III. Symposium, San Francisco, CA, USA, 8-12 April 1996). Edited by: Terminello, L.J.; Mini, S.M.; Ade, H.; Perry, D.L. Pittsburgh, PA, USA: Mater. Res. Soc, 1996. p. 211-18.

28. A.F. Jankowski, I. Jimenez, J.P. Hayes, D.K. Shuh, D.G.J. Sutherland, **J. A. Carlisle**, L. J. Terminello, and F. J. Himpsel, *Near-edge x-ray absorption fine structure examination of chemical bonding in sputter deposited boron and boron-nitride films*, (Applications of Synchrotron Radiation Techniques to Materials Science III. Symposium, San Francisco, CA, USA, 8-12 April 1996). Edited by: Terminello, L.J.; Mini, S.M.; Ade, H.; Perry, D.L. Pittsburgh, PA, USA: Mater. Res. Soc, 1996. p. 207-10.

29. T.A. Callcott, J.J. Jia, L. Zhou, D.L. Ederer, L.J. Terminello, **J. A. Carlisle**, R.C.C. Perera, M.G. Samant, and F. J. Himpsel, *Applications of soft x-ray fluorescence spectroscopy in materials science*, Mat. Res. Soc. Symp. Proc. (in press).

30. R.C.C. Perera; J.J. Jia, T.A. Callcott, **J.A. Carlisle**, *Resonant inelastic scattering in localized solid systems by soft X-ray fluorescence spectroscopy*. (11th International Conference on Vacuum Ultraviolet Radiation Physics, Tokyo, Japan, 27 Aug.-1 Sept. 1995). Journal of Electron Spectroscopy and Related Phenomena **79,** 139 (1996).

31. D.G.J. Sutherland, H. Akatsu, M. Copel, F. J. Himpsel, T. Callcott, **J. A. Carlisle**, D. Ederer, J.J. Jia, I. Jimenez, R. Perera, D.K. Shuh, L. J. Terminello, and W.M. Tong, *Stoichiometry Reversal and depth-profiling in the Growth of Thin Oxynitride Films with N_2O on Si(100) Surfaces* (11th International Conference on Vacuum Ultraviolet Radiation Physics, Tokyo, Japan, 27 Aug.-1 Sept. 1995), J. Electron Spectroscopy and Related Phenomena **80**, 133 (1996).

32. J. J. Jia, T. A. Callcott, Eric L. Shirley, **J. A. Carlisle**, L. J. Terminello, A. Asfaw, D. L. Ederer, F. J. Himpsel, and R.C.C. Perera, *X-Ray Raman scattering in h-BN observed by soft-x-ray fluorescence spectroscopy*, Phys. Rev. Lett. **76**, 4054 (1996).

33. D.L Ederer, **J.A. Carlisle**, J. Jimenez, J.J. Jia, K. Osborn, T.A. Callcott, R.C.C. Perera, J.H. Underwood, L.J. Terminello, A. Asfaw, and F.J. Himpsel, *Study of buried interfaces by soft-x-ray fluorescence spectroscopy excited by synchrotron radiation* (42nd National Symposium of the American Vacuum Society, Minneapolis, MN, October 16-20 1995), J. Vac. Sci. Technol. A **14**, 859 (1996).

34. **J.A. Carlisle**, L.J. Terminello, J.J. Jia, T.A. Callcott, D.L.Ederer, R.C.C. Perera, and F.J. Himpsel, *Resonant soft-x-ray Raman Scattering in graphite and hexagonal boron nitride*, in *Raman Emission by X-ray Scattering*, edited by D.L. Ederer and J.H. McGuire (World Scientific Publishing Co., Singapore, 1996), pp 41-50.

35. J. Jiminez-Mier, D.L. Ederer, U. Diebold, A. Moewes, T.A. Callcott, L. Zhou, J.J. Jia, **J.A. Carlisle**, E. Hudson, A. Asfaw, F.J. Himpsel, and R.C.C. Perera, *Raman scattering at the L-edge of transition metals*, in *Raman Emission by X-ray Scattering*, edited by D.L. Ederer and J.H. McGuire (World Scientific Publishing Co., Singapore, 1996), pp 71-80.

36. T.A. Callcott, L. Zhou, J.J. Jia, L. Lin, D.L. Ederer, L.J. Terminello, **J.A. Carlisle**, and R.C.C. Perera, *The effects of intermediate and final states on electronic resonant Raman scattering observed in the Zn $M_{2,3}$ fluoresecence spectra of Zn_2Sse excited near threshold*, in *Raman Emission by X-ray Scattering*, edited by D.L. Ederer and J.H. McGuire (World Scientific Publishing Co., Singapore, 1996), pp 133-136.

37. **J.A. Carlisle,** A. Chaiken, R.P. Michel, L.J. Terminello, T.A. Callcott, J.J. Jia, D.L. Ederer, *Soft x-ray fluorescence study of buried silicides in antiferromagnetically coupled Fe/Si multilayers*, Phys. Rev. B Rapid Comm. **53**, R8824 (1996).

38. D.G.J. Sutherland, **J.A. Carlisle**, P. Elliker, G. Fox, T.W. Hagler, I. Jimenez, H.W. Lee, K. Pakbaz, L.J. Terminello, S.C. Williams, F.J. Himpsel, D.K Shuh, and W.M. Tong, *Photo-oxidation of electroluminescent polymers studied by core-level photoabsorption spectroscopy*, Appl. Phys. Lett. **68**, 2046 (1996).

39. D.M. Gruen, A.R. Krauss, R. Csencsits, C.D. Zuiker, **J.A. Carlisle**, I. Jimenez, D.G.J. Sutherland, L.J. Terminello, D.K. Shuh, W. Tong, and F.J. Himpsel, *Characterization of nanocrystalline diamond films by core-level photoabsorption*, Appl. Phys. Lett. **68**, 1640 (1996).

40. **J. A. Carlisle**, E. L. Shirley, L. J. Terminello, E. A. Hudson, J. J. Jia, T. A. Callcott, D. L. Ederer, and F. J. Himpsel, *Probing the graphite band structure using resonant soft x-ray fluorescence-Reply*, Phys. Rev. Lett. **76**, 1762 (1996).

41. D.G.J. Sutherland, H. Akatsu, M. Copel, F. J. Himpsel, T. Callcott, **J. A. Carlisle**, D. Ederer, J.J. Jia, I. Jimenez, R. Perera, D.K. Shuh, L. J. Terminello, and W.M. Tong, *Stoichiometry Reversal in the Growth of Thin Oxynitride Films on Si(100) Surfaces*, J. App. Phys. **78**, 6761 (1995).

42. F. J. Himpsel, H. Akatsu, **J. A. Carlisle**, D.G.J. Sutherland, I. Jimenez, L. J. Terminello, J. J. Jia, T. A. Callcott, M.G. Samant, J. Stohr, D. L. Ederer, R.C.C. Perera, W. Tong, and D.K. Shuh, *Surface and Interface Analysis at 3rd Generation Light Sources*, Progress in Surface Science, V**50** N1-4, 37-51 (1995).

43. J. J. Jia, T. A. Callcott, **J. A. Carlisle**, L. J. Terminello, A. Asfaw, J. Jemenez, D. L. Ederer, and R.C.C. Perera, *Occupied electronic states of $CaSi_2$ and CaSi: soft-x-ray fluorescence spectroscopy*, Phys. Rev B **52**, 4904 (1995).

44. **J. A. Carlisle**, Eric L. Shirley, L. J. Terminello, E. A. Hudson, J. J. Jia, T. A. Callcott, D. L. Ederer, and F. J. Himpsel, *Resonant fluorescence studies of novel materials*, Mat. Res. Soc. Symp. Proc. **375**, 15 (1995).

45. **J. A. Carlisle**, L. J. Terminello, E. A. Hudson, J. J. Jia, T. A. Callcott, D. L. Ederer, R.C.C. Perera, and F. J. Himpsel, *Characterization of buried thin films using resonant soft x-ray fluorescence*, Appl. Phys. Lett. **67**, 34 (1995).

46. **J. A. Carlisle**, E. L. Shirley, L. J. Terminello, E. A. Hudson, J. J. Jia, T. A. Callcott, D. L. Ederer, and F. J. Himpsel, *Probing the graphite band structure using resonant soft x-ray fluorescence*, Phys. Rev. Lett. **74**, 1234 (1995).

47. J. J. Jia, T. A. Callcott **,** J. Yurkas, A.W. Ellis, F.J. Himpsel, M.G. Samant, J. Stohr, D.L. Ederer, **J. A. Carlisle**, E. A. Hudson, L. J. Terminello, R. C. C. Perera. amd D.K. Shuh, *First Results from the IBM/TENNESSEE/TULANE/LLNL/LBL Undulator Beamline at the Advanced Light Source*, Rev. Sci. Instrum. **66**,1394 (1995).

48. **J. A. Carlisle**, M. T. Sieger, T. Miller, and T.-C. Chiang, *Photoemission surface extended x-ray absorption fine structure of the surface core-levels on Si(111)-(7×7)*, Mod. Phys. Lett. B. **8**, 1889 (1994).

49. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Extended Photoemission Fine Structure Analysis of the Si(111)-(7×7) Surface Core Levels-Reply*, Phys. Rev. Lett. **72**, 3741 (1994).

50. F. J. Himpsel, D. A. Lapiano-Smith, H. Akatsu, **J. A. Carlisle**, E. A. Hudson, L. J. Terminello, T. A. Callcott, J. J. Jia, M. G. Samant, J. Stohr, D. L. Ederer, and R. C. C. Perera, *Surface Physics with Synchrotron Radiation*, Proceedings of the Symposium on Synchrotron Radiation Techniques in Industrial Research, American Chemical Society Meeting, Washington D.C., August 23-24 1994, ed by L.J. Terminello and K.L. D'Amico, Plenum Press, New York.

51. F. J. Himpsel, H. Akatsu, **J. A. Carlisle**, L. J. Terminello, E. A. Hudson, J. J. Jia, T. A. Callcott, R. C. Perera, M. G. Samant, J. Stohr, and D. L. Ederer, *Core level spectroscopy of thin oxides and oxynitrides*, Proceedings of the Symposium on "Silicon Nitride and Silicon Dioxide Thin Insulating Films," Electrochemical Society, San Francesco, CA, May 1994.

52. **J. A. Carlisle**, L. J. Terminello, E. S. Hudson, E. L. Shirley, F. J. Himpsel, J. J. Jia, T. A. Callcott, R. C. C. Perera, S. G. Louie, M. G. Samant, and D. L. Ederer, *Occupied and Unoccupied Orbitals of C_{60} and C_{70} Probed with C 1s Emission and Absorption*, Mat. Res. Soc. Symp. Proc. **349**, 245 (1994).

53. **J. A. Carlisle**, L. J. Terminello, E. S. Hudson, A. V. Hamza, E. L. Shirley, F. J. Himpsel, D. A. Lapiano-Smith, J. J. Jia, T. A. Callcott, R. C. C. Perera, D. K. Shuh, S. G. Louie, J. Stöhr, M. G. Samant, and D. L. Ederer, *Occupied and Unoccupied Orbitals of C_{60} and C_{70}*, Mol. Cryst. Liq. Cryst. **256**, 819 (1994).

54. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Ge chemisorption and alloying on the Si(111)-(7×7) surface*, Phys. Rev. B. **49**, 13600 (1994).

55. **J. A. Carlisle**, M.T. Sieger, T. Miller, and T.-C. Chiang, *Extended Photoemission Fine Structure Analysis of the Si(111)-(7×7) Surface Core Levels*, Phys. Rev. Lett. **71**, 2955 (1993).

56. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Angle-resolved photoemission study of the submonolayer phases of Pb on Ge(111)*, Phys. Rev. B. **47**, 10342 (1993).

57. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Photoemission study of Pb on Ge(111)*, Phys. Rev. B **47**, 3790 (1993).

58. D.-S. Lin, **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Dimer charge asymmetry determined by photoemission from epitaxial Ge on Si(100)-(2×1)-Reply*, Phys. Rev. Lett. **69**, 552 (1992).

59. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Photoemission study of the growth, desorption, Schottky barrier formation, and atomic structure of Pb on Si(111)*, Phys. Rev. B **45**, 3400 (1992).

60. **J. A. Carlisle**, T. Miller, and T.-C. Chiang, *Atomic origins of surface core levels on Si(111)–(7×7) studied by site-dependent Ge substitution*, Phys. Rev. B **45**, 3811 (1992).

61. **J. A. Carlisle**, T. R. Dillingham, D. R. Chopra, B. Gnade, and G. Smith, *Study of the Low-pressure chemical-vapor-deposited tungsten-silicon interface: Interfacial Fluorine*, J. Applied Phys. **65**, 2313 (1989).

62. K. Min, **J. Carlisle**, B. Doughty, C. Jones, and C. Rogers, *A fast triangular transform and its applications*, Proceedings: ICASSP 87. 1987 International Conference on Acoustics, Speech, and Signal Processing (Cat. No.87CH2396-0). IEEE. 1987, pp.1811-14 vol.3. New York, NY, USA.

63. J. L. Meir, C. E. Coughnour, **J. A. Carlisle**, and G. O. Carlisle, *The magnetic properties of a series of Copper II Aspirinates*, Inorgania Chemica Acta **106**, 159 (1985).

64. E.S. Alambar, **J. A. Carlisle**, and G. O. Carlisle, *Synthesis and magnetic properties of Manganese II Salicylate Dihydrate*, Inorgania Chemica Acta **78**, L65 (1983).

INVITED TALKS AND SEMINARS:

1. Electronic Structure of Nanostructured Materials, presented at the University of Wisconsin-Madison, Department of Physics, September 20, (2001)
2. Correlating Morphology with Electronic Structure and Photoluminescence Properties in Oxidized Silicon Nanoclusters, presented at the PacifiChem Conference, Honolulu, HI, December 14-19 (2000).
3. Electronic Structure of 1D nanowires on silicon surfaces, presented at the University of Missouri-Rolla, Department of Physics, November 1, 2000.
4. Correlating morphology with electronic structure in oxidized silicon nanoclusters, presented at Argonne National Laboratory, March 19, 2000
5. Study of the changes in morphology and electronic structure in oxidized silicon nanoclusters using Soft-x-ray fluorescence spectroscopy at the Advanced Light Source, presented in the Department of Chemistry, Virginia Commonwealth University, September 4, 1999.
6. *The materials physics of low-dimensional systems*, presented at the University of Richmond, Department of Physics, Richmond, Virginia, October 21, 1999.
7. *Electronic Structure of Nanowires grown on Semiconductor Substrates*, presented at the Workshop on Low-Dimensional Systems, Stoughton, WI, October 9, 1999.
8. *Electronic structure of Ag-induced row structures on Si(5 5 12)*, presented at the Annual Users Meeting, Synchrotron Radiation Center, Stoughton, WI, October 8, 1999.
9. *Electronic Structure of Nanoengineered Materials*, presented at Phillip-Morris Corporation, August 17, 1999.
10. *Soft-x-ray fluorescence studies of solids, buried thin films, and clusters,* presented at the VUV (Vacuum Ultra-Violet) conference, San Francisco, California, August 3, 1998.
11. *Using ESCA to probe the electronic structure of complex materials*, presented at the High Technology Materials Consortium Short-Courses on Surface and interfacial engineering in the design and fabrication of materials, Virginia Commonwealth University, May 18-19 (1998).

12. *Surface Physics at VCU*, presented at the Physics Learning Workshop, Virginia Commonwealth University, Richmond, VA, October 21, 1997.
13. *Soft-x-ray fluorescence spectrscopy: Teaching an old dog new tricks at the Advanced Light Source*, presented at the National Institute of Standards and Technology, October 14, 1997.
14. *Applications of synchrotron-based characterization techniques to complex materials systems*, presented at the High Technology Materials Consortium Short-Courses on Surface Analysis and Adhesion science, Virginia Commonwealth University, May 19-20, 1997.
15. *Synchrotron studies of complex materials systems*, presented at the College of William & Mary, Department of Physics, Williamsburg, Virginia April 3,1997.
16. *Fluorescence Spectroscopy as a new probe of band structure, localization, and elementary excitations in solids*, presented at the Workshop on Soft-X-Ray Fluorescence, Lawrence Berkeley National Laboratory (October 23, 1996).
17. *Soft-X-Ray Fluorescence Studies of Reduced Dimensional Systems at the Advanced Light Source*, presented at Northern Arizonia University, Department of Physics, Flaggstaff, Arizona (April 22, 1996).
18. *Soft-X-Ray Fluorescence Studies of Reduced Dimensional Systems at the Advanced Light Source*, presented at Virginia Commonwealth University, Department of Physics, Richmond, Virginia (March 8, 1996).
19. *Soft-X-Ray Fluorescence and Absorption Studies of Reduced Dimensional Systems at the Advanced Light Source*, presented at Lawrence Livermore National Laboratory, Livermore, California (December 15, 1995).
20. *Resonant Fluorescence Studies of Novel Materials*, presented at the Raman Emission by X-rays (REX-I) Conference, New Orleans, Louisiana, (December 7-8, 1995).
21. *Resonant Soft-X-Ray Raman Studies of Interesting Materials Systems at the Advanced Light Source*, presented at the UC-Berkeley Department of Physics, Berkeley, California (December 4, 1995).
22. *Materials Physics on Beamline 8.0 at the ALS*, presented at the Annual Meeting of the Advanced Light Source User's Association, Lawrence Berkeley National Laboratory, Berkeley, California (October 23-24, 1995).
23. *Electronic Structure of Novel Materials Probed via Soft-X-Ray Emission and Absorption*, presented at Argonne National Laboratory, Argonne, Illinois (August 23, 1995).
24. *Adsorbate-induced Reconstructions on Semiconductor Surfaces Studied by Photoemission and High-Energy Electron Diffraction*, presented at Lawrence Livermore National Laboratory, Livermore, California (November 20, 1993).
25. *Photoemission Studies of Pb-induced Reconstructions on Semiconductor Surfaces*, presented at the Naval Research Laboratory, Washington, DC (June 25, 1993)
26. *Photoemission Studies of Pb-induced Reconstructions on Semiconductor Surfaces*, presented at the Center for Materials Chemistry, The University of Texas at Austin, Austin, Texas (June 23, 1993)
27. *Photoemission Studies of Pb-induced Reconstructions on Semiconductor Surfaces*, presented at Penn State University, State College, Pennsylvania (June 17, 1993)

CONTRIBUTED TALKS (LAST THREE YEARS ONLY)

1. Fabrication Techniques and Integration Processes for a New Ultrananocrystalline Diamond (UNCD) -Based MEMS Technology and Characterization of UNCD Mechanical Properties, O. Auciello, A.V. Sumant, D.M. Gruen, J.A. Carlisle, J. Birrell, N.A. Moldovan, D.C. Mancini, M. Angadi, H.D. Espinosa, B.C. Brorok, presented at the 48th National Symposium of the American Vacuum Society, San Francisco, CA, October 28-November 2 (2001).
2. STM Studies of the Ca/Si(111) System, J.W. Dickinson, S.C. Erwin, J.A. Carlisle, and A.A. Baski, presented at the 48th National Symposium of the American Vacuum Society, San Francisco, CA, October 28-November 2 (2001).
3. Synthesis and characterization of highly conducting nitrogen doped ultrananocrystalline diamond films, J. Birrell, O. Auciello, S. Bhattacharyya, J.A. Carlisle, L.A. Curtiss, A.N. Goyette, D.M. Gruen, A.R. Krauss, J. Schlueter, A. Sumant, and P. Zapol, presented at the 48th National Symposium of the American Vacuum Society, San Francisco, CA, October 28-November 2 (2001).

4. Micromachining of ultrananocrystalline diamond, N. Moldovan, O. Auciello, J. Carlisle, R. Divan, D. Gruen, A. Jayatissa, A. Krauss, D.C. Mancini, A. Sumant, J. Tucek, presented at the SPIE conference on Micromachining and Microfabrication, San Francisco, CA, October 21-25 (2001)

5. Mechanical properties of ultrananocrystalline diamond thin films using nanoindentation, A.V. Sumant, J. Birrell, O. Auciello, D.M. Gruen, D. Ersoy, D. Expinosa, B.C. Prorok, and E. Stach, presented at the Spring Meeting of the Materials Research Society, San Franciso, CA, April 13-18 (2001).

6. Density functional based tight binding study of C_2 and CN deposition on (100) diamond surface, Michael Sternberg, Thomas Frauenheim, Peter Zapol, Larry A. Curtiss, John Carlisle, Dieter M. Gruen presented at the Spring Meeting of the Materials Research Society, San Franciso, CA, April 13-18 (2001).

7. Effect of Nitrogen Incorporation on the Electronic Properties and Morphology of Ultrananocrystalline Diamond (UNCD) Thin Films, James Birrell, O. Auciello, S. Bhattacharyya, J. A. Carlisle, J.M. Gibson, D.M. Gruen, J.A. Schlueter, presented at the Spring Meeting of the Materials Research Society, San Franciso, CA, April 13-18 (2001).

8. Morphology and Electronic Structure of the Ca/SI(111) System, A.A. Baski, S.C. Erwin, M.S. Turner, J.W. Dickinson, and J.A. Carlisle, presented at the March Meeting of the American Physical Society, March 12-16 (2001).

9. High n-type conduction in ultrananocrystalline diamond thin films via nitrogen incorporation, S. Bhattacharyya, J. Schuelter, J. Birrell, O. Auciello, J.A. Carlisle, and D.M. Gruen, presented at the Fall meeting of the Materials Research Society, Boston, MA, November 30-December 4 (2000).

10. Correlation of Electronic Structure with Photoluminescence Properties in Oxidized Silicon Nanoclusters, J.A. Carlisle, I. N. Germanenko, Y. Pithawalla, M. Dongol, and M. S. El-Shall, presented at the 47th National Symposium of the American Vacuum Society, Boston, MA, November 2-6 (2000)

11. Morphology, Photoluminescence, and Electronic Structure in Oxidized Silicon Nanoclusters, J.A. Carlisle, I. N. Germanenko, Y. Pithawalla, M. Dongol, and M. S. El-Shall, presented at the 8th International Conference on Electronic Spectroscopy and Structure--ICESS8 University of California, Berkeley, Clark Kerr Campus, Berkeley, CA: August 8-12, 2000.

12. Electronic Structure of 1D Ca rows on Si(111) M. S. Turner, K. M. Jones, A. A. Baski, and J. A. Carlisle, presented at the 8th International Conference on Electronic Spectroscopy and Structure--ICESS8 University of California, Berkeley, Clark Kerr Campus, Berkeley, CA: August 8-12, 2000.

13. Electronic Structure of the Clean and Ag Covered Si(5 5 12) Surface Studied Using Photoemission and Scanning-Tunneling Spectroscopy, K.M. Jones, S.R. Blankenship, H. H. Song, A.A. Baski, and J.A. Carlisle, presented at the 8th International Conference on Electronic Spectroscopy and Structure--ICESS8 University of California, Berkeley, Clark Kerr Campus, Berkeley, CA: August 8-12, 2000.

14. *Formation of 1D Ca row structures on Si(111),* M.S. Turner, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the 3rd Annual Research Symposium & Exhibits, Graduate Student Association, Virginia Commonwealth University, April 14, 2000.

15. *Morphology and Electronic Structure of Oxidized Silicon Nanoclusters*, J.A. Carlisle, I. N. Germanenko, Y. Pithawalla, M. Dongol, and M. S. El-Shall, presented at the March Meeting of the American Physical Society, Minneapolis, MN, March 20-24 (2000).

16. *Comparison between kinematical calculations and experimental RHEED rocking-curves obtained using the one-beam condition*, S. Wen and J.A. Carlisle, presented at the March Meeting of the American Physical Society, Minneapolis, MN, March 20-24 (2000).

17. *Electronic Structure of Sub-Stoichiometric Iron Aluminides*, B.V Reddy, S.C. Deevi, J.A. Carlisle and P. Jena, presented at the March Meeting of the American Physical Society, Minneapolis, MN, March 20-24 (2000).

18. *Formation of 1D Ca row structures on Si(111),* M.S. Turner, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the international symposium on cluster and nanostructured interfaces, Richmond, VA, October 25-28 (1999).

19. *Morphology and electronic structure of Ag nanowires on Si(5 5 12)*, S.R. Blankenship, H. Song, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the international symposium on cluster and nanostructured interfaces, Richmond, VA, October 25-28 (1999).

20. *Formation of 1D Ca row structures on Si(111),* M.S. Turner, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the 8th Annual Industry-Academia Minisymposium, organized by the High Technology Materials Center, Virginia Commonwealth University, November 22, 1999.

21. *Electronic structure of Ag nanowires on Si(5 5 12)*, S.R. Blankenship, H. Song, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the 8th Annual Industry-Academia Minisymposium, organized by the High Technology Materials Center, Virginia Commonwealth University, November 22, 1999.

22. *Morphology and electronic structure of 1D Ca-induced rows on the Si(111) surface*, M.S. Turner, K.M. Jones, A.A. Baski, and J.A. Carlisle, presented at the 46th National Symposium of the American Vacuum Society, Seattle, WA, November 2-6 (1999).

23. *Effect of Atmospheric Oxidation on the electronic and photoluminescence properties of silicon nanocrystals*, I.N. Germanenko, M. Dongol, Y.B. Pithawalla, J.A. Carlisle, and M. Samy El-Shall, presented at the 1st IUPAC Workshop on New Directions in Chemistry Workshop on Advanced Materials: Nanostructured Systems International Union of Pure & Applied Chemistry, Hong Kong July 14-18 (1999).

24. *Core-hole effects in resonant inelastic soft-x-ray scattering*, J.A. Carlisle, S.R. Blankenship, E.L. Shirley, L.J. Terminello, T.A. Callcott, D.L. Ederer, R.C.C. Perera, and F.J. Himpsel, presented at the Centennial Meeting of the American Physical Society, Atlanta, GA, March 22-26 (1999).

25. *Electronic Structure of the clean and Ag-covered Si(5 5 12) surface* S. R. Blankenship, J.A. Carlisle, and A. A. Baski, presented at the Centennial Meeting of the American Physical Society, Atlanta, GA, March 22-26 (1999).

26. *Reconstructions of Ca on Si(111)* M.S. Turner, A.A. Baski, and J.A. Carlisle, presented at the Centennial Meeting of the American Physical Society, Atlanta, GA, March 22-26 (1999).

27. *Ag-induced reconstructions of the Si(5 5 12) surface*, S.R. Blankenship, H. Song, A.A. Baski, and J.A. Carlisle, presented at 6th Annual Industry-Academia Minisymposium, High Technnology Materials, Virginia Commonwealth University, November 16, 1998.

28. *Reconstructions of Ag on High-Index Silicon Surfaces*, S.R. Blankenship, H. Song, A.A. Baski, and J.A. Carlisle, presented at the 45th National Symposium of the American Vacuum Society, Baltimore, MD, November 2-6 (1998).

29. *Surface Oxidation of Weblike Agglomeration of Germanium Quantum Dots Produced by a Laser Vaporization-Controlled Condensation Technique*, S.Li, S. Wen, M. Wiess, J. A. Carlisle, and E. S. El-Shall, presented at the 45th National Symposium of the American Vacuum Society, Baltimore, MD, November 2-6 (1998).

30. *Assaying the morphology and electronic structure of nanoclusters and nanostructured thin films*. J.A. Carlisle, T. Van Buuren, S. Li, L.J. Terminello, and M.S. El-Shall, presented at the 5th Annual Consortium on Nanostructured Materials workshop, Oct, 28-29 (1998).

31. *Band-structure and core-hole effects in resonant inelastic soft-x-ray scatting: Experiment and theory*, J.A. Carlisle, E.L. Shirley, L.J. Terminello, J.J. Jia, T.A. Callcott, D.L. Ederer, R.C.C. Perera, and F.J. Himspel, presented at the Annual Advanced Light Source Users Meeting, October 22-23, (1998).

32. *Tailered growth of Ag row structures and Ag-induced reconstructions on Si(5 5 12)*, H. Wen, S. Blackenship, J.A. Carlisle, and A. A. Baski, presented at the March Meeting of the American Physical Society, Los Angles, CA, March 21-25 (1998).

Teaching Experience

Semester	*Course Number*	*Course Title*	*Semester Hours*	*Number of Students*
2000 Spring	208	University Physics II	5	57
	550	Graduate Laboratory	3	8
	697	Thesis Research	1-9	2
	491	Nanostructured Materials	3	2
	397	Independent Study	1	3
1999 Fall	207	University Physics I	5	74
	697	Thesis Research	1-9	2
	690	Research Seminar	1	5
	491	Nanostructured Materials	3	16
	397	Independent Study	1	4
1999 Spring	207	University Physics I	5	143
	697	Thesis Research	1-9	3
	690	Research Seminar	1	5
	492	Honors Project	3	2
	397	Independent Study	1	4
1998 Fall	207E	University Physics I	5	74
	697	Thesis Research	1-9	4
	690	Research Seminar	1	4
	492	Honors Project	2	1
	397	Independent Study	1	3
1998 Spring	641	Advanced Solid State Physics	3	5
	697	Thesis Research	1-9	4
	691	TOP: Surface Physics	3	1
	690	Research Seminar	1	6
	492	Honors Project	2	2
	397	Independent Study	1	3
1997 Fall	208	University Physics II	5	74
	697	Thesis Research	3	2
	690	Research Seminar	1	4
1997 Spring	208E	University Physics II	5	27
	697	Thesis Research	3	2
	690	Research Seminar	1	5
	492	Honors Project	2	1
1996 Fall	208E	University Physics II	5	11
	690	Research Seminar	1	5

CURRICULUM DEVELOPMENT PROJECTS

1. Major Revision of Physics Graduate Curriculum (Fall 99 & Spring 00): Played the *lead*, *decisive* role in organizing, writing, binding, submitting, and presenting an 88-page Revised Physics Graduate Program proposal to the Department, College, and University Committees. The cornerstone of the revised program is the M.S. Plan of Study, which replaced the previous "track" approach and the required core courses in the old curriculum. In the revised curriculum, each student, in consultation with his or her graduate advisor, will propose a detailed M.S. Plan of Study**,** to be approved by the graduate curriculum committee. The Plan of Study will consist primarily of core physics graduate courses (e.g. Quantum Mechanics, Electromagnetism), but may also consist of courses from different parts of the University, including the School of Education. This student-centered approach gives the program the flexibility to train students in diverse ways.

2. Web Study Guides (PHYS 207, 208) Developed a new component of the calculus-based physics courses, whereby students, working in groups of two-five, developed study guides for each chapter covered in the course. These study guides consist of a three-page section that gives a synopsis of the contents of each chapter, as well as a summary of problem types, tricks & tips, world-wide-web links to sites related to the chapter material, and ten fully-solved homework problems. These study guides were presented orally to the rest of the class in addition to being posted on the course website to be used be all the students as a aid for learning the class material.

3. Nanostructured Materials and Technology (PHYS 491, Fall 99 & Spring 00) Co-developed a course taught across the Physics, Chemistry, and Engineering disciplines, which emphasized how knowledge from many different scientific backgrounds is needed for the development of modern materials systems. Students participating in this course will also carryout synthesis and characterization of advanced material systems in each of the individual course instructor's laboratories. (multilayers and surface systems in my case).

4. Video-Capture-based Laboratories (PHYS 207, 208, 320, 450) Development and application of Video-capture experiments for the demonstration and learning of the laws of motion (Newton's Laws, Conservation of Energy, Momentum, etc…) in intermediate and advanced mechanics experiments. A total of six laboratories have been developed for the introductory mechanics laboratory (207L), and has been part of a wider project to revitalize the intermediate physics teaching laboratories.

5. Experimental Techniques in Solid-State Physics (PHYS 641, 450) Developed a month-long portion of an advanced solid-state physics course (641 Spring 98) which emphasized how experimental techniques are used to characterize the geometric and electronic structure of modern complex materials. Techniques discussed in detail included synchrotron-based photoemission, photoabsorption, and soft-x-ray fluorescence spectroscopies. Also have introduced physics majors in our advanced laboratories techniques course (PHY 450) to the use of Reflection High-Energy Electron Diffraction and High-Resolution X-Ray Diffraction for the study of surface and thin-film systems. This is part of an effort to involve advanced undergraduate students directly in my research laboratory.

MAJOR UNIVERSITY, COLLEGE, AND DEPARTMENT COMMITTEES

University Service:

1. Advisory Committee to the Office of Sponsored Programs on Electron Research Administration, (Herbert Chermside, Chair)
2. Faculty Senate (alternate)
3. Faculty Council (alternate)
4. STAR Advising
5. Destination Imagination
6. Project BEST

College Service:

1. Technology Committee (R.D. Rugg, Chair)
2. Served on a ad hoc committee called by the Associate Dean Al Sneden, to advise on the construction of the new Life Sciences Building.

Departmental Service:

1. Graduate Program Director
2. Faculty Search Committee (2 yrs)
3. 207-208 Lab Development Committee (3 yrs)
4. Departmental Recruitment Committee (3 yrs)
5. Colloquium Committee (2 yrs)
6. Undergraduate Curriculum Committee
7. Laboratory Safety Officer (3 yrs)
8. Dave Pappas Equipment Committee
9. Graduate Advisory Committee (1 yr)
10. Graduate Curriculum Committee (2 yrs)
11. Department Review Committee

Community Service:

1. VJAS student projects
2. Destination Imagination (Odyssey of the Mind)
3. Project BEST