

LIST OF PUBLICATIONS AND PRESENTATIONS

Paul M. Voyles

“Evaluation of connectivity, flux pinning and upper critical field contributions to the critical current density of bulk MgB₂”, A. Matsumoto, H. Kumakura, H. Kitaguchi, B. J. Senkowicz, M. C. Jewell, E. E. Hellstrom, Y. Zhu, P. M. Voyles, D. C. Larbalestier, submitted to Appl. Phys. Lett.

“Length scale of medium-range order in amorphous Zr₇₀Pd₃₀ measured by variable resolution fluctuation electron microscopy”, Z. Y. Liu, D. J. Miller, R. E. Cook, D. J. Sordelet, M. J. Kramer, C. Jenks, and P. M. Voyles, submitted to Phys. Rev. Lett.

“Computational thermodynamics to identify Zr-Ti-Ni-Cu-Al alloys with high glass forming ability”, H. Cao, D. Ma, K-C. Hsieh, L. Ding, W. G. Stratton, P. M. Voyles, Y. Pan, M. Cai, J. T. Dickinson, Y. A. Chang, Acta Mat., to be published.

“Prospects for 3D, nanometer-resolution imaging by confocal STEM” J. J. Einspahr and P. M. Voyles, Ultramicroscopy, to be published.

“Imaging single atoms with Z-contrast STEM in two and three dimensions” P. M. Voyles, Microchimica Acta, to be published.

“Electron beam induced crystallization of amorphous Al-based alloys in the TEM” W. G. Stratton, J. Hamann, J. H. Perepezko, and P. M. Voyles, Intermetallics **14**, 1061 (2006).

“Homogeneous Silica Formed by the Oxidation of Si(100) in Hyperthermal Atomic Oxygen”, M. Kisa, T. K. Minton, K. van Benthem, W. G. Stratton, X. Chen, L. Li, P. M. Voyles, S. J. Pennycook, and J. C. Yang, J. Spacecraft and Rockets **43**, 431 (2006).

“Catalytic Oxidation of CO by Aqueous Polyoxometalates on Carbon-supported Gold Nanoparticles” Won Bae Kim, G. J. Rodriguez-Rivera, S. T. Evans, T. Voithl, J. J. Einspahr, P. M. Voyles and J. A. Dumesic, J. Catalysis **235**, 327 (2005).

“Aluminum Nanoscale Order in Amorphous Al₉₂Sm₈ Measured by Fluctuation Electron Microscopy”, W.G. Stratton, J. Hamann, J.H. Perepezko, P.M. Voyles, X. Mao and S.V. Khare, Appl. Phys. Lett. **86**, 141910 (2005).

“Increased Ordering in the Amorphous SiO_x due to Hyperthermal Atomic Oxygen”, M. Kisa, W. G. Stratton, T. K. Minton, K. van Benthem, S. J. Pennycook, P. M. Voyles, X. Chen, L. Li and J. C. Yang, in *Materials for Space Applications*, M. Chipara, D.L. Edwards, S. Phillips, R. Benson, eds. Mat. Res. Soc. Symp. Proc. **851**, NN9.5 (2005).

“Turning Cutting-Edge Research into Secondary Curriculum”, G. M. Zenner, W. C. Crone, J. A. Gimm, K. W. Lux, P. M. Voyles, N. L. Abbott, A. P. Cina, A. P. Comins, J. Tabora, P. Tuchscherer, T. Tuchscherer, P. J. Whitsett, C. G. Widstrand, in *Communicating Materials Science—Education for the 21st Century*, S. Baker, F. Goodchild, W. C. Crone, S. Rosevear eds. Mat. Res. Soc. Symp. Proc. **861E**, PP3.3 (2004).

“Medium-range order in high Al-content amorphous alloys measured by fluctuation electron microscopy” W. G. Stratton, P. M. Voyles, J. Hamann, J. H. Perepezko *Microsc. Microanal.* **10 (Suppl. 2)** 788-789 (2004).

“Evidence from atomistic simulations of fluctuation electron microscopy for preferred local orientations in amorphous silicon”, S. V. Khare, S. M. Nakhmanson, P. M. Voyles, P. Keblinski, J. R. Abelson, *Appl. Phys. Lett* **85**, 745 (2004).

“Depth-Dependent Imaging of Individual Dopant Atoms in Silicon” P. M. Voyles, D. A. Muller, and E. J. Kirkland, *Microscopy and Microanalysis* **10**, 291 (2004).

“Medium-Range Order in High Al-content Amorphous Alloys Measured by Fluctuation Electron Microscopy”, W.G. Stratton, J. Hamann, J.H. Perepezko, and P.M. Voyles, in *Amorphous and Nanocrystalline Metals*, R. Busch, T. C. Hufnagel, J. Eckert, A. Inoue, W. Johnson, A. Yavari, eds. *Mat. Res. Soc. Symp. Proc.* **806**, MM9.4 1-6 (2004).

“Evidence for a New Class of Defects in Highly *n*-doped Si: Donor-Pair-Vacancy-Interstitial Complexes” P. M. Voyles, D. J. Chadi, P. H. Citrin, D. A. Muller, J. L. Grazul, P. A. Northrup, and H-J. L. Gossmann, *Phys. Rev. Lett* **91**, 125505 (2003).

“A new class of defects in highly n-doped silicon” P. H. Citrin, P. M. Voyles, D. J. Chadi, and D. A. Muller, *Physica B* **340-342**, 784 (2003).

“A Quantitative Measure of Medium-Range Order in Amorphous Materials from Transmission Electron Micrographs” R. K Dash, P. M. Voyles, J. M. Gibson, M. M. J. Treacy, and P. Keblinski, *J. Phys: Cond. Mat.* **15**, S2425 (2003).

“Imaging Individual Atoms Inside Crystals with ADF-STEM” P. M. Voyles, J. L. Grazul, and D. A. Muller, *Ultramicroscopy* **96**, 251 (2003).

“Increasing Medium-Range Order in Amorphous Silicon via Ion and Neutral Bombardment” J. E. Gerbi, P. M. Voyles, M. M. J. Treacy, J. M. Gibson, and J. R. Abelson, *Appl. Phys. Lett*, **82**, 3665 (2003).

“Medium-range Order in Amorphous Silicon Measured by Fluctuation Electron Microscopy” P. M. Voyles and J. R. Abelson, in *Critical Review of Amorphous and Microcrystalline Materials and Solar Cells*, H. Fritzsche and S. Guha, eds.; *Solar Energy Materials and Solar Cells* **78**, 85 (2003) (invited review).

“High-Performance Quantum-Dot Nanocomposites for Nonlinear-Optical and Optical-Gain Applications” M. A. Petruska, A. V. Malko, P. M. Voyles, and V. I. Klimov, *Adv. Mat.* **15**, 610 (2003).

“Dopant Mapping for the Nanotechnology Age” M. R. Castell, D. A. Muller, and P. M. Voyles, *Nature Materials* **2**, 129 (2003) (commentary).

“Morphology and Crystallization Kinetics in HfO₂ Thin Films Grown by Atomic Layer Deposition” M.-Y. Ho, H. Gong, G. D. Wilk, B. W. Busch, M. L. Green, P. M. Voyles, D. A. Muller, M. Bude, W. H. Lin, A. See, M. E. Loomans, S. K. Lahiri, P. I. Räisänen, *J. Appl. Phys.* **93**, 1477 (2003).

“Fluctuation Microscopy in the STEM” P. M. Voyles and D. A. Muller, *Ultramicroscopy* **93**, 147 (2002).

“Atomic-Scale Imaging of Individual Dopant Atoms and Clusters in Highly n-type Bulk Si” P. M. Voyles, D. A. Muller, J. Grazul, P. H. Citrin, and H.-J. L. Gossmann, *Nature* **416**, 826 (2002).

“50 nm Vertical Replacement-Gate (VRG) nMOSFETs with ALD HfO₂ and Al₂O₃ Gate Dielectrics” J.M. Hergenrother *et al.* (40 authors, Voyles 34th), *Int. Electron Device Meeting Tech. Digest, IEEE 2001*, p. 3.1.1.

“Control of Medium Range Order in Amorphous Silicon via Ion and Neutral Bombardment” J. E. Gerbi, P. M. Voyles, M. M. J. Treacy, J. M. Gibson, Wangchun C. Chen, B. J. Hauser, and J. R. Abelson, in *Amorphous and Heterogeneous Silicon-Based Thin Films – 2001*, J. B. Boyce *et al.*, eds.; *Mat. Res. Soc. Symp. Proc.* **664**, (2001), p. A27.3.1.

“Fluctuation Microscopy Studies of Medium-Range Order Structures in Tetrahedral Amorphous Semiconductors” Xidong Chen, J. M. Gibson, J. Sullivan, T. Friedman, and P. M. Voyles, in *Nano- and Microcrystalline Semiconductor Materials and Structures*, P. M. Fauchet *et al.*, eds.; *Mat. Res. Soc. Symp. Proc.* **638**, (2001), p. F14.40.1.

“Experimental Procedures and Data Analysis for Fluctuation Microscopy” P. M. Voyles, M. M. J. Treacy, J. M. Gibson, H-C. Jin, and J. R. Abelson, in *Advances in Materials Problem Solving with the Electron Microscope*, J. Bentley *et al.*, eds.; *Mat. Res. Soc. Symp. Proc.* **589**, (2001), p. 155.

“Ion-implanted Amorphous Silicon Studied by Variable Coherence TEM” J.-Y. Cheng, J. M. Gibson, P. M. Voyles, M. M. J. Treacy, and D. C. Jacobson, in *Advances in Materials Problem Solving with the Electron Microscope*, J. Bentley *et al.*, eds.; *Mat. Res. Soc. Symp. Proc.* **589**, (2001), p. 247.

“Absence of an Abrupt Phase Change from Polycrystalline to Amorphous in Silicon with Deposition Temperature” P. M. Voyles, J. E. Gerbi, M. M. J. Treacy, J. M. Gibson, and J. R. Abelson, *Phys. Rev. Lett.* **86**, 5514 (2001).

“The Structure and Physical Properties of Paracrystalline Atomistic Models of Amorphous Silicon” P. M. Voyles, N. Zotov, S. M. Nakhmanson, D. A. Drabold, J. M. Gibson, M. M. J. Treacy, and P. J. Koblinski, *J. Appl. Phys.* **90**, 4437 (2001).

“Increased Medium-Range Order in Amorphous Silicon with Increased Substrate Temperature” P. M. Voyles, J. E. Gerbi, M. M. J. Treacy, J. M. Gibson, and J. R. Abelson, *J. Non-Cryst. Solids* **293-295**, 45 (2001).

“Realistic Models of Paracrystalline Silicon” S. M. Nakhmanson, P. M. Voyles, N. Mousseau, G.T. Barkema, and D. A. Drabold, *Phys. Rev. B* **63**, 235207 (2001).

“Models of Paracrystalline Silicon with a Defect-Free Bandgap” S. M. Nakhmanson, N. Mousseau, G. T. Barkema, P. M. Voyles, and D. A. Drabold, *Int. J. Mod. Phys. B* **15**, 3253, (2001).

“Comparative Fluctuation Microscopy Study of Medium-Range Order in Hydrogenated Amorphous Silicon Deposited by Various Methods” P. M. Voyles, M. M. J. Treacy, H-C.

Jin, J. R. Abelson, J. M. Gibson, J. Yang, S. Guha, and R. S. Crandall, in *Amorphous and Heterogeneous Silicon Thin Films 2000*, H. M. Branz, *et al.* eds.; Mat. Res. Soc. Symp. Proc. **609**, (2000) p. A2.4.1.

“Topological Signatures of Medium Range Order in Amorphous Semiconductor Models” M. M. J. Treacy, P. M. Voyles, and J. M. Gibson, in *Amorphous and Heterogeneous Silicon Thin Films 2000*, H. M. Branz, *et al.* eds.; Mat. Res. Soc. Symp. Proc. **609**, (2000) p. A2.5.1.

“Thermodynamics of Paracrystalline Silicon” P. M. Voyles, M. M. J. Treacy, and J. M. Gibson, in *New Methods, Mechanisms, and Models of Vapor Deposition*, H. N. G. Wadley, G. Gilmer, and W. Barker, eds., Mat. Res. Soc. Symp. Proc. **616**, (2000) p. 47.

“Fluctuation Microscopy: A probe of Atomic Correlations in Disordered Materials” P. M. Voyles, J. M. Gibson, and M. M. J. Treacy, *J. Electron Microscopy* **49**, 259 (2000).

“Atom Pair Persistence in Disordered Materials from Fluctuation Microscopy” J. M. Gibson, M. M. J. Treacy, and P. M. Voyles, *Ultramicroscopy* **83**, 169 (2000).

“Schläfli Cluster Topological Analysis of Medium Range Order in Paracrystalline Amorphous Semiconductor Models” M. M. J. Treacy, P. M. Voyles, and J. M. Gibson, *J. Non-Cryst. Sol.* **266**, 150 (2000).

“An Improved Method for Detecting Subtle Spatial Structures by Fluctuation Microscopy” Toshiya Iwai, P. M. Voyles, J. M. Gibson, and Yoshitsugu Oono, *Phys. Rev. B* **60**, 191 (1999).

“The Structure of Ion-Implanted Amorphous Silicon” J. M. Gibson, J-Y. Cheng, P. M. Voyles, M. M. J. Treacy, and D. C. Jacobson, in *Microstructural Processes in Irradiated Materials*, S. J. Zinkle, G. Lucas, and R. Ewing, eds.; Mat. Res. Soc. Symp. Proc. **540**, (1999) p. 27.

“Changes in the Medium Range Order of a-Si:H Thin Films Observed by Variable Coherence TEM” J. M. Gibson, M. M. J. Treacy, P. M. Voyles, H-C. Jin, and J. R. Abelson, in *Amorphous and Microcrystalline Silicon Science and Technology 1998*, R. Schropp *et al.*, eds.; Mat. Res. Soc. Symp. Proc. **507**, (1999) p. 837.

“Enhanced Crystallinity of Microcrystalline Silicon Thin Films Using Deuterium in Reactive Magnetron Sputter Deposition at 230 °C” J. E. Gerbi, P. M. Voyles, J. M. Gibson, and J. R. Abelson, in *Amorphous and Microcrystalline Silicon Science and Technology 1998*, R. Schropp, *et al.* eds.; Mat. Res. Soc. Symp. Proc. **507**, (1999) p. 429.

“Structural disorder induced in hydrogenated amorphous silicon by light soaking” J. M. Gibson, M. M. J. Treacy, P. M. Voyles, H-C. Jin, and J. R. Abelson, *Appl. Phys. Lett.* **73**, 3093 (1998).

“Total reaction and 2n-removal cross sections of 20-60A MeV $^{4,6,8}\text{He}$, $^{6-9,11}\text{Li}$, and ^{10}Be on Si.” R. E. Warner, R. A. Patty, P. M. Voyles, *et al.*, *Phys. Rev. C* **54**, 1700 (1996).

CONFERENCE PRESENTATIONS

EUCAS 2005, “Systematic effects of heat treatment condition on J_c , H_{c2} , and H_{irr} and resistivity of pure and SiC-doped MgB_2 tapes”, (contributed talk presented by A. Matsumoto).

Microscopy and Microanalysis 2005, “Confocal Scanning Transmission Electron Microscopy: Theoretical Analysis of 3D Imaging” (contributed talk presented by John J. Einspahr).

Microscopy and Microanalysis 2005, “Estimation of the characteristic length scale of medium-range ordered regions in a-Si thin films using variable resolution fluctuation electron microscopy” (poster presented for L. Nitalla).

TMS Annual Meeting 2005, “Analysis of Devitrification Kinetics and Fragility Characteristics of Amorphous $Al_{92}Sm_8$ ” (contributed talk, presented by Joseph Hamann).

Bulk Metallic Glasses IV, “Nanoscale Order in Amorphous Metals Measured by Fluctuation Electron Microscopy” (contributed talk presented by W. G. Stratton).

Midwest Microscopy and Microanalysis Society Meeting, Urbana-Champaign, 2005, “Variable Resolution Fluctuation Electron Microscopy of Precursor Nucleation Sites in $Al_{92}Sm_8$ ”, (poster presented by W. G. Stratton).

Midwest Microscopy and Microanalysis Society Meeting, Urbana-Champaign, 2005, “3D Imaging with 1 nm Resolution Predicted Using Confocal STEM” (poster presented by J. J. Einspahr).

Midwest Microscopy and Microanalysis Society Meeting, Urbana-Champaign, 2005 “Medium-Range Order in Amorphous Metals”, (invited talk).

European Microbeam Analysis Society / International Union of Microbeam Analysis Societies Joint Meeting, 2005, “Imaging Single Atoms with Z-contrast STEM in Two and Three Dimensions” (invited talk).

Minnesota Microscopy and Microanalysis Society Meeting, 2005, “Imaging Single Atoms with Z-contrast STEM: Current Results and Future Prospects”, (invited talk).

EDGE Electron Energy Loss Spectroscopy Workshop, 2005, “Analysis of Single Atoms in Two and Three Dimensions”, (invited talk).

Materials Research Society Spring Meeting 2005, “Imaging Electrically Deactivating Defects in Si One Impurity at a Time” (invited talk).

American Physical Society March Meeting 2005, “Medium-Range Structure in Al-based Amorphous Metals from Fluctuation Electron Microscopy” (invited talk).

Materials Research Society Fall Meeting 2004, “Imaging Single Atoms with Z-contrast STEM: Current Results and Future Prospects” (invited talk).

Materials Research Society Fall Meeting 2004, “Increased ordering in the amorphous SiO_x due to AO” (contributed talk, presented by Maja Kisa).

ARO Workshop on Buried Nanostructure Imaging, 2004 (participant).

Workshop on Mesoscopic and Nanoscopic Science, Future Scientific Direction for the Advanced Photon Source, 2004, “Future Nanocharacterization with Electrons: sub-Ångstrom, sub-eV, and Single Atom” (invited talk).

Microscopy and Microanalysis 2004 Pre-meeting Congress on Microscopy in an Aberration-Free Environment, “Potential for Optical Sectioning in Aberration-Corrected Z-Contrast STEM” (invited talk).

Microscopy and Microanalysis 2004, “Medium-range Order in High Aluminum-Content Metallic Glass Measured by Fluctuation Electron Microscopy “ (contributed talk, presented by W. G. Stratton).

Materials Research Society Fall Meeting, 2003, “Medium-range Order in $Al_{92}Sm_8$ Metallic Glass from Fluctuation Electron Microscopy” (contributed talk, presented by W.G. Stratton).

Microscopy and Microanalysis 2003, “ADF-STEM Imaging of Dopants and Defect Nanoclusters in Si” (invited talk).

Microscopy and Microanalysis 2003, “Z-contrast Imaging of Nanostructure in the STEM” (invited talk).

Fluctuation Electron Microscopy Summer Workshop 2003, “FEM in the STEM” (invited talk).

Fluctuation Electron Microscopy Summer Workshop 2003, “Medium-Range Order in High Al-content Metallic Glass” (poster, presented by W. G. Stratton).

University of Wisconsin NanoExpo 2003, “Scanning Transmission Electron Microscopy: Science Meets Technology at the Nanoscale” (poster).

Spring Materials Research Society Meeting, 2003: “Evidence For a New Defect in Highly n-type Si from Atomic-Resolution Channeling on Individual Dopant Atoms” (poster).

American Ceramics Society Glass and Optical Materials Division Meeting 2002: “Fluctuation Electron Microscopy Reveals Medium-Range Order in Glassy Materials” (invited talk).

Microscopy and Microanalysis, 2002: “Imaging Single Dopant Atoms and Nanoclusters in Highly n-Type Bulk Si” (poster).

American Physical Society March Meeting, 2002: “Imaging of Individual Dopants Atoms and Nanoclusters in Solids” (invited talk).

Microscopy and Microanalysis, 2001: “Fluctuation Microscopy in the STEM” (contributed talk).

Spring Materials Research Society Meeting, 2001: “Fluctuation Microscopy as a Probe of Medium-Range Order” (invited talk).

Spring Materials Research Society Meeting, 2001: “Paracrystalline Medium-Range Order in Amorphous Silicon” (invited talk).

American Physical Society March Meeting 2001: “Increasing Order With Substrate Temperature in Amorphous Silicon” (contributed talk).

8th International Conference on the Structure of Non-Crystalline Materials, 2000: “The Amorphous to Polycrystalline Structural Transition in Silicon” (contributed talk).

Spring Materials Research Society Meeting, 2000: “Medium-Range Order in Hydrogenated Amorphous Silicon Measured by Fluctuation Microscopy” (contributed talk).

Fall Materials Research Society Meeting, 1999: “Medium-Range Structure of Amorphous Semiconductors Revealed By Fluctuation Microscopy” (contributed talk).

18th International Conference on Amorphous and Microcrystalline Semiconductors Science and Technology, 1999: “Topological and Real Space Analysis of Paracrystalline Models of Tetrahedral Amorphous Semiconductors: Differences in Medium Range Order” (contributed talk).

Spring Material Research Society Meeting, 1998: “Changes in the Medium-Range Order of a-Si Films Observed by Variable Coherence TEM” (poster).

SEMINARS ON FLUCTUATION MICROSCOPY

Dept. of Materials Science and Engineering, Pennsylvania State University, Oct. 2005.

Dept. of Physics, Washington University, April 2005.

Dept. of Materials Science and Engineering, Johns Hopkins University, Feb. 2005

Dept. of Materials Science and Engineering, University of Michigan, Sept. 2003.

Electronic Materials and Devices Group, Dept. of Electrical Engineering, Princeton University, Apr. 2001.

Condensed Matter and Surface Sciences Program, Ohio University, Feb. 2001.

Dept. of Physics, Oberlin College, Feb. 2001.

Dept. of Materials Science and Engineering, University of Virginia, Dec. 2000.

Materials Science Division, Argonne National Laboratory, Oct. 2000.

Dept. of Material Science and Engineering, Johns Hopkins University, Sept. 2000.

Microstructural Physics Group, Cavendish Laboratory, Cambridge University, Aug. 2000.

Electron Microscopy and Microanalysis Group, Materials Dept., Oxford University, Aug. 2000.

SEMINARS ON IMAGING INDIVIDUAL DOPANT ATOMS IN SILICON

Dept. of Chemistry Inorganic Materials Seminar, University of Wisconsin, Madison, Oct. 2005.

Dept. of Chem. Eng. and UW-UPRM Partnership in Research and Education in Materials, University of Puerto Rico, Mayagüez, Sept. 2004.

Dept. of Physics, University of Wisconsin, Milwaukee, Oct. 2003.

Materials Science Program, University of Wisconsin, Madison, Feb. 2003.

Dept. of Materials Science & Engineering, Rensselaer Polytechnic Institute, Jan. 2003.

Dept. of Materials Science & Engineering, University of Illinois at Urbana-Champaign, Feb. 2002.

Dept. of Materials Science & Engineering, University of Wisconsin, Madison, Feb. 2002.

School of Applied Physics, Cornell University, Feb. 2002.

Dept. of Physics, Michigan State University, Mar. 2002.

Dept. of Materials Science & Engineering, Johns Hopkins University, Apr. 2002.

Dept. of Materials Science & Engineering, University of Virginia, May 2002.