Jason D. Fowlkes

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Education

The University of Tennessee-Knoxville	Materials Science & Engineering	B. S. 1997
The University of Tennessee-Knoxville	Materials Science & Engineering	M.S. 1999
The University of Tennessee-Knoxville	Materials Science & Engineering	Ph.D. 2002

Professional Experience

2007 – Present	Research Staff Member, Center for Nanophase Materials Sciences, ORNL
2004 – 2007	Research Assistant Professor, The University of Tennessee-Knoxville
2003 – 2004	Postdoctoral Research Fellow, The University of Tennessee-Knoxville

Professional and Synergistic Activities

American Vacuum Society, 2003 – 2005
Materials Research Society, 2002 – 2005
Tau Beta Pi, Engineering Honors Society, 1997

Honors and Awards

Sigma Xi Scientific Presentation Competition Winner, 2002
Outstanding Graduate Student Materials Science and Engineering, 2002

Publications (74 peer reviewed publications)
Full publication list follows CV.

Research Synopsis

1. *Charged Particle Beam-Induced, Direct-Write Deposition/Etching*
   Nanoscale direct-write assembly methods, such as focused particle beam processing, require precise understanding and control of the relevant electron/ion–vapor precursor–solid interactions where energy beams on the order of 1–10 nm dictate the assembly/removal of material at the confluence of the particle beam, adsorbed precursor and substrate. We determine precursor–substrate interaction parameters relevant for the electron/ion beam induced deposition methods through a combination of experiments and simulations. Monte Carlo simulations of the electron–substrate interaction are combined with finite difference simulations of precursor–substrate interactions to unravel the parameters by fitting to experimental results.

2. *Self and Directed Assembly of Thin, Liquid Metallic Films*
   Physical vapor deposition combined with nanolithography methods are used to deposit metallic materials with highly non-equilibrium shapes. Capillary, inertial and viscous forces dictate the mass transport of the metal once liquefied. The initial shape of the metallic feature is used to harness liquid surface instabilities for the self assembly of metallic nanoparticles. Pulsed laser irradiation is used to liquefy the metal features where rapid heating and cooling rates and nanosecond melt lifetimes are achievable. Directed assembly is possible by imposing periodic fluctuations onto the initial metal geometry which translates into highly precise arrays of metallic nanoparticles/nanocaps.

3. *Solute Diffusion in Crowded Environments*
   Biomolecular transport in cellular environments occurs in crowded surroundings where molecular reactivity and diffusion can be significantly altered when compared with dilute solution conditions. By the prescribed design of spatially restricted environments, micro- and nanofabrication techniques can be used to replicate specific features of such systems. We implement Monte Carlo, Brownian based simulation methods to design, and fabricate, micro- and nano- size containers and crowding features intended to control the reaction and diffusion of matter at biologically relevant length and time scales.

Publications

Jason D. Fowlkes, Ph. D.
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Peer-Reviewed Publications

1. Y. Wu, J. D. Fowlkes, N. A. Roberts, J. A. Diez, L. Kondic, A. G. Gonzalez and P. D. Rack, "Competing liquid phase instabilities during pulsed laser induced self–assembly of copper rings into ordered nanoparticle arrays on SiO_2", *Langmuir* (*on-line*)
2. M. Fuentes–Cabrera, B. R. Rhodes, M. I. Baskes, H. Terrones, J. D. Fowlkes, M. L. Simpson and P. D. Rack, "Controlling the Velocity of Jumping Nanodroplets via Their Initial Shape and Temperature", *ACS Nano* 5, 7130 (2011)
3. N. P. Mortensen, J. D. Fowlkes, M. Maggart, M. J. Doktycz, J. P. Nataro, G. Drusano and D. P. Allision, "Effects of sub–minimum inhibitory concentrations of ciprofloxacin on enteroaggregative Escherichia Coli and the role of the surface protein dispersin", *International Journal of Antimicrobial Agents* 38, 27 (2011)
4. J. D. Fowlkes, L. Kondic, J. Diez, Y. Wu and P. D. Rack, "Self–Assembly versus Directed Assembly of Nanoparticles via Pulsed Laser Induced Dewetting of Patterned Metal Films", *Nano Letters* 11, 2478 (2011)
5. M. Fuentes–Cabrera, B. H. Rhodes, J. D. Fowlkes, A. Lopez–Benzanilla, H. Terrones, M. L. Simpson and P. D. Rack, "Molecular dynamics study of the dewetting of copper on graphite and graphene: Implications for nanoscale self – assembly", *Physical Review E* 83, 041603 (2011)
6. Y. Wu, J. D. Fowlkes and P. D. Rack, "The optical properties of Cu–Ni nanoparticles produced via pulsed laser dewetting of ultrathin films: The effect of nanoparticle size and composition on the Plasmon response", Journal of Materials Research 26, 277 (2011)
7. R. Clearfield, J. G. Railsback, R. C. Pearce, D. K. Hensley, J. D. Fowlkes, M. Fuentes–Cabrera, M. L. Simpson, P. D. Rack and A. V. Melechko, "Reactive solid–state dewetting of Cu–Ni films on silicon", *Applied Physics Letters* 97, 253101 (2010)
8. B. R. Srijanto, S. T. Retterer, J. D. Fowlkes and M. J. Doktycz, "Nanostructured silicon membranes for control of molecular transport", *Journal of Vacuum Science and Technology B* 28, C6P48 (2010)
9. J. D. Fowlkes, Y. Wu and P. Rack, "Directed Assembly of Bi–Metallic Nanoparticles by Pulsed Laser Induced Dewetting: a Unique Time and Length Scale Regime", *ACS Applied Materials & Interfaces* 2, 2153 (2010)
10. Y. Wu, J. D. Fowlkes, P. D. Rack, J. A. Diez and L. Kondic, "On the Breakup of Patterned Nanoscale Copper Rings into Nanoparticles: Competing Instability and Transport Mechanisms", *Langmuir* 26, 11972 (2010)

11. C. K. Choi, J. D. Fowlkes, S. T. Retterer, P. Siuti, S. Iyer and M. J. Doktycz, “Surface Charge- and Space-Dependent Transport of Proteins in Crowded Environments of Nanotailored Posts”, *ACS Nano* 4, 3345 (2010)
12. J. D. Fowlkes, M. J. Doktycz and P. D. Rack, “An optimized nanoparticle separator enabled by electron beam induced deposition”, *featured article*, *Nanotechnology* 21, 165303 (2010)
13. J. D. Fowlkes and P. D. Rack, “Fundamental Electron–Precursor–Solid Interactions Derived from Time–Dependent Electron–Beam–Induced–Deposition Simulations and Experiments”, *ACS Nano* 4, 1619 (2010)
14. A. Dhawan, M. Gerhold, A. Madison, J. Fowlkes, P. E. Russell, T. Vo–Dinh and D. N. Leonard, “Fabrication of Nanodot Plasmonic Waveguide Structures Using FIB Milling and Electron Beam – Induced Deposition”, *Scanning* 31, 1 (2009)
15. B. L. Fletcher, J. T. Fern, K. Rhodes, T. E. McKnight, J. D. Fowlkes, S. T. Retterer, D. J. Keffer, M. L. Simpson and M. J. Doktycz, “Effects of ultramicroelectrode dimensions on the electropolymerization of polypyrrole”, *Journal of Applied Physics* 105, 124312 (2009)
16. N. P. Mortensen, J. D. Fowlkes, C. J. Sullivan, D. P. Allison, N. B. Larsen, S. Molin, and M. J. Doktycz, “Effects of Colistin on Surface Ultrastructure and Nanomechanics of Pseudomonas aeruginosa Cells”, *Langmuir* 25, 3728 (2009)
17. L. Kondic, J. A. Diez, P. D. Rack, Y. Guan and J. D. Fowlkes, “Nanoparticle assembly via the dewetting of patterned thin metal lines: Understanding the instability mechanisms”, *Physical Review E* 79, 026302 (2009)
18. Y. Guan, J. D. Fowlkes, S. T. Retterer, M. L. Simpson, and P. D. Rack, “Nanoscale lithography via electron beam induced deposition”, *Nanotechnology* 19, 505302 (2008)
19. J. D. Fowlkes, B. L. Fletcher, S. T. Retterer, A. V. Melechko, M. L. Simpson, and M. J. Doktycz, “Size–Selectivity and Anomlaous Subdiffusion of Nanoparticles through Carbon Nanofiber–Based Membranes”, *Nanotechnology* 19, 415301 (2008)
20. D. A. Smith, J. D. Fowlkes and P. D. Rack, ”Simulating the effects of surface diffusion on electron beam induced deposition via a three – dimensional Monte Carlo simulation”, *Nanotechnology* 19, 415704 (2008)
21. P. D. Rack, Y. Guan, J. D. Fowlkes, A. V. Melechko and M. L. Simpson, “Pulsed laser dewetting of patterned thin metal films: A means of directed assembly”, *Applied Physics Letters* 92, 223108 (2008)
22. K. L. Klein, S. J. Randolph, J. D. Fowlkes, L. F. Allard, H. M. Meyer III, M. L. Simpson and P. D. Rack, “Single–crystal nanowires grown via electron–beam–induced deposition”, *Nanotechnology* 19, 345705 (2008)
23. K. D. Sorge, K. L. Klein, A. V. Melechko, C. L. Finkel, O. Malkina, Th. Leventouri, J. D. Fowlkes, P. D. Rack, and M. L. Simpson, “Magnetic Properties of Fe–Co Catalysts used for Carbon Nanofiber Synthesis”, *Journal of Applied Physics* 104, 033909 (2008)
24. D. A. Smith, J. D. Fowlkes, and P. D. Rack, “Understanding the Kinetics and Nanoscale Morphology of Electron Beam Induced Deposition via a Three Dimensional Monte Carlo Simulation: The Effects of the Precursor Molecule and the Deposited Material”, *Small* 4, 1382 (2008)
25. K. L. Klein, A. V. Melechko, T. E. McKnight, S. T. Retterer, P. D. Rack, J. D. Fowlkes, D. C. Joy, and M. L. Simpson, “Surface characterization and functionalization of carbon nanofibers”, *Journal of Applied Physics* 103, 061301 (2008)

26. B. L. Fletcher, S. T. Retterer, T. E. McKnight, A. V. Melechko, J. D. Fowlkes, M. L. Simpson, and M. J. Doktycz, "Actuatable Membranes Based on Polypyrrole – Coated Vertically Aligned Carbon Nanofibers", *ACS Nano*, 2, 247 (2008)
27. A. V. Melechko, K. L. Klein, J. D. Fowlkes, D. K. Hensley, I. A. Merkulov, T. E. McKnight, P. D. Rack, J. A. Horton, and M. L. Simpson, "Control of carbon nanostructure: From nanofiber towards nanotube and back", *Journal of Applied Physics* 102, 074314 (2007)
28. P. D. Rack, J. D. Fowlkes, and S. J. Randolph, "In-situ probing of the growth and morphology in electron-beam-induced deposited nanostructures", *Nanotechnology*, 18, 465602 (2007)
29. B. L. Fletcher, T. E. McKnight, J. D. Fowlkes, D. P. Allison, M. L. Simpson and M. J. Doktycz, "Controlling the dimensions of carbon nanofiber structures through the electropolymerization of pyrrole", *Synthetic Metals* 157, 282 (2007)
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31. D. A. Smith, J. D. Fowlkes, and P. D. Rack, "A Nanoscale Three Dimensional Monte-Carlo Simulation of Electron Beam Induced Deposition with Gas Dynamics", *Nanotechnology*, 18, 265308 (2007)
32. J. D. Fowlkes, J. M., Fitz–Gerald, and P. D. Rack, "Ultraviolet emitting $(Y_{1-x}Gd_x)_2O_{3-\delta}$ thin films deposited by radio frequency magnetron sputtering: structure–property–thin film processing relationships", *Thin Solid Films* 515, 3488 (2007)
33. Y. Deng, J. D. Fowlkes, J. M. Fitz – Gerald, and P. D. Rack, "Thin Film rf Magnetron Sputtering of Gadolinium Doped Yttrium Aluminum Garnet Ultraviolet Emitting Materials", *Optical Mat.* 29, 183 (2006)
34. J. D. Fowlkes, J.– M., Fitz–Gerald, and P. D. Rack, "Ultraviolet emitting $(Y_{1-x}Gd_x)_2O_{3-\delta}$ thin films deposited by radio frequency magnetron sputtering: Combinatorial modeling, synthesis, and rapid characterization", *Thin Solid Films* 510, 68 (2006)
35. J. D. Fowlkes, E. D. Hullander, B. L. Fletcher, S. T. Retterer, A. V. Melechko, D. K. Hensley, M. L. Simpson, and M. J. Doktycz, "Molecular Transport in a Crowded Volume Created from Vertically–Aligned Carbon Nanofibers: A Fluorescence Recovery after Photobleaching Study", *Nanotechnology* 17, 5659 (2006)
36. M. S. Dhindsa, N. R. Smith, J. Heikenfeld, P. D. Rack, J. D. Fowlkes, M. J. Doktycz, A. V. Melechko, and M. L. Simpson, "Reversible Electrowetting of Vertically Aligned Superhydrophobic Carbon Nanofibers", *Langmuir* 22, 9030 (2006)
37. S. J. Randolph, J. D. Fowlkes, and P. D. Rack, "Focused, Nanoscale Electron–Beam–Induced Deposition and Etching", *Critical Reviews in Solid State and Materials Sciences* 31, 1–35 (2006)
38. J. D. Fowlkes, A. V. Melechko, K. L. Klein, P. D. Rack, D. A. Smith, D. K. Hensley, M. J. Doktycz, and M. L. Simpson, "Control of catalyst particle crystallographic orientation in vertically aligned carbon nanofiber synthesis", *Carbon* 44, 1503 (2006)
39. K. L. Klein, A. V. Melechko, J. D. Fowlkes, P. D. Rack, D. K. Hensley, H. M. Meyer III, L. F. Allard, T. E. McKnight, and M. L. Simpson, "Formation of Ultrasharp Vertically Aligned Cu–Si Nanocones by a DC Plasma Process" *Journal of Physical Chemistry B*. 110, 4766 (2006)
40. T. E. McKnight, C. Peeraphatdit, S. W. Jones, J. D. Fowlkes, B. L. Fletcher, K. L. Klein, A. V. Melechko, M. J. Doktycz, and M. L. Simpson, "Site–Specific

Biochemical Functionalization along the Height of Vertically Aligned Carbon Nanofiber Arrays", Chemical Materials 18, 3203 (2006)

41. T. Leventouri, A. V. Melechko, K. D. Sorge, K. L. Klein, J. D. Fowlkes, P. D. Rack, I. M. Anderson, J. R. Thompson, T. E. McKnight, and M. L. Simpson, "Magnetic alloys in nanoscale biomaterials", *Metallurgical and Materials Transactions A – Physical Metallurgy and Materials Science* 37A, 3424 (2006)
42. J. D. Fowlkes, B. L. Fletcher, E. D. Hullander, K. L. Klein, D. K. Hensley, A. V. Melechko, M. L. Simpson, and M. J. Doktycz, "Tailored transport through vertically aligned carbon nanofibre membranes; controlled synthesis, modelling, and passive diffusion experiments", *Nanotechnology* 16, 3101 (2005)
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44. J. D. Fowlkes, S. J. Randolph, and P. D. Rack, "Growth and simulation of high – aspect ratio nanopillars by primary and secondary electron – induced deposition", *J. of Vac. Sci. Tech. B* 23, 2825 (2005)
45. K. L. Klein, A. V. Melechko, P. D. Rack, J. D. Fowlkes, H. M. Meyer, and M. L. Simpson, "Cu – Ni Composition Gradient for the Catalytic Synthesis of Vertically Aligned Carbon Nanofibers", *Carbon* 43, 1857 (2005)
46. E. D. Specht, P. D. Rack, A. Rar, G. M. Pharr, E. P. George, J. D. Fowlkes, H. Hong, and E. Karapetrova, Metastable phase evolution and grain growth in annealed nanocrystalline Cr–Fe–Ni films", *Thin Solid Films* 493, 307 (2005)
47. A. Rar, J. Frafjord, J. D. Fowlkes, E. D. Specht, P. D. Rack, M. L. Santella, E. P. George, and G. M. Pharr, "PVD Synthesis and High–Throughput Property Characterization of Ni–Fe–Cr Alloy Libraries", *J. of Meas. Sci. & Technol.* 16, 46 (2005)
48. Y. Deng, J. D. Fowlkes, J. M. Fitz – Gerald, and P. D. Rack, "Combinatorial thin film synthesis of Gd – doped $Y_3Al_5O_{12}$ ultraviolet emitting materials", *Appl. Phys. A*, 80, 787 (2005)
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53. J. M. Fitz – Gerald, J. G. Hoekstra, R. K. Bansal, J. D. Fowlkes, and P. D. Rack, "Temperature Dependent Cathodoluminescence Characterization of Ultraviolet Emitting Films Grown by Pulsed Laser Deposition", MRS Symposium Proceedings, "Advanced Optical Processing of Materials", eds. D. B. Chrisey, M. Dinescu, I. W. Boyd, and A. V. Rode, Vol. 764, Y1.4 (2003)
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Applications for Wide-Bandgap Semiconductors", eds. S. J. Pearton, J. Han, A.G. Baca, J.-I. Chyi, and W. H. Chang, Vol. 764, C7.12 (2003)

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