ADAM C. POWELL, IV

11 Michigan Dr.
Natick, MA 01760-1334
(617) 290-8831

apowell@moxst.com
http://www.moxst.com/

Professional Interest Commercialization of low-cost clean technologies which advance sustainability, energy efficiency, and renewable energy.

Education

Massachusetts Institute of Technology — Cambridge, MA
Ph.D. in Materials Engineering — 1992–1997
Thesis title: *Transport Phenomena in Electron Beam Melting and Evaporation.* Advisors: Professor Julian Szekely, Professor Uday Pal. Research included pilot-scale experimentation at Sandia National Laboratories, using FIDAP software to model liquid titanium fluid flow and heat transfer with natural convection in an electron beam melting hearth, applying the Direct Simulation Monte Carlo method to vapor transport in electron beam evaporation, 1-D heat transfer model for rapid assessment of effects of electron beam characteristics and scan frequency on evaporation rates of alloying elements. Minor in Japanese. GPA: 4.9/5.0.

Massachusetts Institute of Technology — Cambridge, MA
S.B. in Materials Science and Engineering, S.B. in Economics — 1988–1992
Economics thesis title: *A Model of the Automobile Recycling System.* Course work included: Materials Science core and electives in metallurgy and polymers; Economics core and electives in government regulation and the environment; computer programming in C, Scheme, Fortran and Postscript; mathematical analysis and topology; concentration in Political Science; three years of Japanese including Technical Japanese for Materials Science and Related Engineering. GPA: 4.7/5.0.

Experience

Metal Oxygen Separation Technologies, Inc. — Natick, MA
Chief Technology Officer — 2008–Present
Leading technology development in a startup company scaling up SOM Electrolysis as the lowest-cost method for making magnesium, solar-grade silicon and other metals.

Opennovation — Newton, MA
Principal — 2007–Present
Engineering consulting in transport phenomena, modeling, and materials selection, with particular specialty in electrochemical processes, polymer membrane fabrication, evaporation processes, and high-performance computing.

Veryst Engineering LLC — Needham, MA
Managing Engineer — 2006–2007
Technical consulting in failure analysis, phase inversion processes used to make polymer membranes, medical devices, primary metal production, and use of advanced materials in product design.

Massachusetts Institute of Technology — Cambridge, MA
Thomas B. King Assistant Professor of Materials Engineering — 1999–2006
Research in computational materials science, particularly extension of the phase field methodology for simulating structure formation in materials. Extensions include incorporating fluid-structure interactions and electrochemical reactions, with application to semisolid metal behavior, phase inversion casting of polymers, and electrolysis in molten slags and salts. Teaching: *Transport Phenomena in Materials Engineering*, *Materials Processing*, *Introduction to Modeling and Simulation*, *Kinetic Processes in Materials*.

National Institute of Standards and Technology — Gaithersburg, MD
Metallurgist — 1997–1999
Worked in the Center for Theoretical and Computational Materials Science, research focused on modeling of solder droplet shape and its effect on mechanical deformation, with application to optical fiber alignment and new flip-chip package design.

Sandia National Laboratories — Albuquerque, NM
OSSP Summer Intern — Summers 1992–1996
Pilot-scale experimentation in Electron Beam Melting and Refining, focused on characterization of alloy element evaporative losses and melt velocities, in conjunction with MIT doctoral thesis.

Massachusetts Institute of Technology — Cambridge, MA
Teaching Assistant — Fall, 1994
Transport Phenomena in Materials Engineering, taught by Prof. Julian Szekely. Taught recitations, tutored students, wrote homework assignments, exams, solutions and lecture notes and typeset them in LaTeX, graded all assignments, set up World-Wide-Web homepage with all course materials publicly available.

Nippon Steel Corporation — Kawasaki, Japan
Summer Research Intern — Summer, 1991
Characterization of aluminum oxide thin films deposited by radio frequency planar magnetron sputtering, and modeling of interfacial delamination. All research interactions conducted in Japanese.

TDK Corporation — Ichikawa, Japan
Summer Research Intern — Summer, 1990
Preparation and analysis of iron-chromium multi-layer thin films with giant

magnetoresistance (GMR) properties. Samples were prepared by molecular beam epitaxy, and magnetic hysteresis and GMR properties were measured and modeled. All research interactions and final presentation conducted in Japanese.

Other Appointments

Columbia University Earth Engineering Center — New York, NY
Research Associate — November, 2009–present

Boston University — Boston, MA
Visiting Scholar — January–December, 2007
Instructor — January, 2008–Present

NRC National Materials Advisory Board — Washington, DC
Committee on Integrated Computational Materials Engineering (ICME) — September, 2006–April, 2008

Massachusetts Institute of Technology — Cambridge, MA
Visiting Assistant Professor — July, 2006–Present

Howard University CREST Center for Nanotechnology — Washington, DC
Advisory Board Member — December, 2004–Present

University of Tokyo International Research Center for Sustainable Materials — Tokyo, Japan
Foreign Cooperative Researcher — October, 2004–Present

Awards

Institute of Materials, Minerals and Mining (IOM^3) Mann Redmayne Medal for paper by Suput *et al.* 2008

TMS Materials Processing & Manufacturing Division Education Resource Award — December, 2007

MIT Alumni Association Volunteer Honor Roll of Service (Awarded to alumni who contribute significantly to student life) — March, 2005

Federal Laboratories Consortium Technology Transfer Award — April, 1999

Wulff Award for Excellence in Teaching (Best Teaching Assistant in Materials Science and Engineering) — June, 1995

AT&T CRFP Fellowship — 1992–1997

Funding

Government Grants

2005–2009: National Science Foundation, "NSDL Materials Digital Library Pathway: Hub for Materials Education and Research," P.I. Laura Bartolo (Kent State University), $2,579,421: $480,000 to MIT, $160,000 to my group.

2005–2006: National Science Foundation, "Solid Oxide Membrane Electrolysis with Rotating Cathode (SOMERC), a Low-Cost Process for High Purity Titanium," P.I. Adam Powell, $160,000: $72,000 to MIT and my group.

2003–2005: National Science Foundation, "MatDL.org' NSDL Digital Library," P.I. Laura Bartolo (Kent State University), total $808,574: $107,000 to MIT and my group.

2003: Sandia National Laboratories, "Bubble Flotation in Plasma Arc Melting," P.I. Adam Powell, $15,000.

2002–2005: Office of Naval Research, "Polymer Membranes for Water Treatment," P.I. Anne Mayes (MIT), total $320,000: $150,000 to my group.

2002: Sandia National Laboratories, "Multicomponent Evaporation Modeling," P.I. Adam Powell, $19,000.

2001–2003: National Science Foundation, "Green's Functions Research and Education Enhancement Network (GREEN)," P.I. Laura Bartolo (Kent State University), total $608,000: $36,356 to MIT and my group.

2000–2001: National Institute of Standards and Technology, "`Julian` Boundary Element Code," P.I. Adam Powell, $20,942.

Industrial Contracts and Consulting

2005: Rohm & Haas Electronic Materials CMP, Inc., "Model-Based Development of Materials Microstructures," $13,000.

2004: Advanced Micro Devices, Inc., "Distributed Computation and Visualization," $5,000 in-kind.

2003: Advanced Micro Devices, Inc., "Distributed Computation and Visualization," $10,000 in-kind.

2002: Advanced Micro Devices, Inc., "Distributed Computation and Visualization," $30,000 +$10,000 in-kind.

2002: Walsin-Lihwa USA, Inc., "Active and Passive Alignment of Optical Fibers", $25,000.

2001: Honeywell, Inc., "Process Development in Electrolytic Refining of Titanium," $24,000.

Internal MIT Funding

2001: Lord Foundation Grant, $50,000.

Research

Graduate Research Supervision

Supervisor, Doctoral: Yi-Cheung Lok, "Second-Phase Defects and Mechanical Behavior of Castings," MIT Department of Materials Science and Engineering, completed May, 2006.

Supervisor, Doctoral: Wanida Pongsaksawad, "Mathematical Modeling of a New Titanium Reduction Process," MIT Department of Materials Science and Engineering, completed May, 2006.

Supervisor, Doctoral: Bo Zhou, "Simulations of Polymeric Membrane Formation in 2D and 3D," MIT Department of Materials Science and Engineering, completed January, 2006.

Supervisor, Masters: Jorge Vieyra-Salas, "Detailed Modeling of Phase Transformations in Semisolid Metal Processing," MIT Department of Materials Science and Engineering, completed June, 2005.

Supervisor, Masters: David Dussault, "Modeling of Electric Field-Enhanced Smelting and Refining of Steel," MIT Department of Materials Science and Engineering, completed January, 2002.

Committee, Doctoral: Soobhankar Pati, "Electrochemical Characterization of Solid Oxide Membrane (SOM) Electrolyzer for Production of High Purity Hydrogen," Boston University Division of Materials Science and Engineering, completed March, 2010.

Committee, Doctoral: Peter Zink, "Doped Lanthanum Ferrite Cathode Development for Use in Single-Step Co-Fired Solid Oxide Fuel Cells," Boston University Division of Materials Science and Engineering, completed September, 2009.

Committee, Doctoral: Kenneth Avery, "Morphology and Kinetics of Phase Transformations in Transition Metal Oxide Compounds For Use As Cathodes in Lithium Ion Batteries," MIT Department of Materials Science and Engineering, completed June, 2008.

Committee, Doctoral, Yu Mao, "Chemical Vapor Deposition of Functional Polyacrylic Thin Films," MIT Department of Chemical Engineering, completed June, 2005 (co-advisor).

Committee, Doctoral: Raul Martinez, "The Early Stages of Microstructural Evolution and Fluidity of Rheocast Alloys," MIT Department of Materials Science and Engineering, completed June, 2004.

Committee, Doctoral: Jin-Woo Park, "A Framework for Designing Interlayers in Ceramic-to-Metal Joints," MIT Department of Materials Science and Engineering, completed February, 2002.

Undergraduate Research Supervision

Bachelors Thesis Supervisor: Christopher Kinney, "Water Modeling of the SOMERC Titanium Smelting Process," completed May, 2004.

Undergraduate Research Opportunities Program (UROP): Luis Fernandez, "Automotive Uses of Solid Oxide Fuel Cells (SOFC)," Spring 2006.

UROP: Tania Chan and Yushan Kim, "Engineering Collagen Meshes for Skin Cell Growth," Fall 2005–Spring 2006.

UROP: Andres Becerra, "Physical and Mathematical Modeling of the SOMERC Titanium Smelting Process," Spring 2005–Spring 2006.

UROP: Phi Ho, "Structure Formation in Collagen Scaffolds," Fall 2004–Spring 2004.

UROP: Anna Bershteyn, "Fluid Infiltration of Periodic Structures Formed by Block Copolymers," Fall 2003–Spring 2004.

UROP: Kevin McComber, "Character Dynamics in Grain Boundary Networks," Fall 2003–Spring 2004.

UROP: Edward Barnard, "Computation Infrastructure and Visualization in Simulations of Polymer Membrane Structure Formation," Spring–Summer 2004.

UROP: Muyinatu Lediju, "Solder Surface Tension and Optical Fiber Alignment," Fall 2002–Spring 2004.

UROP: Pi-Han Lin, "Lens Array for Flat 3-D Visualization of Data," Summer–Fall 2001.

UROP: Ojonimi Ocholi, "Distributed Rendering for Data Visualization in the `Illuminator` Framework," Spring 2001–Fall 2002.

UROP: Raja Jindal, "Phase Field Modeling of Dendritic Solidification," Spring 2000.

Publications

Refereed Publications

1. P. Mendez and A. Powell, "Influence of Heat Transfer on the Application of Solid Lubricant on Hot Dies," *Scripta Mater.* **59**(7):784–787 (October 2008)

2. M. Suput, R. DeLucas, S. Pati, G. Ye, U. Pal and A. Powell, "Solid Oxide Membrane Technology for Environmentally Sound Production of Titanium," *Mineral Processing and Extractive Metallurgy* **117**(2):118–122 (June 2008).
3. T. Pollock, J. Allison, D. Backman, M. Boyce, M. Gersh, E. Holm, R. LeSar, M. Long, A. Powell, J. Schirra, D. Whitis and C. Woodward. *Integrated Computational Materials Engineering.* Washington, DC: National Academies Press, 2008.
4. A. Powell and R. Arroyave, "Open Source Tools for Materials and Process Modeling," *JOM* **60**(5):40–47 (May 2008).
5. L.M. Bartolo, S.C. Glotzer, C.S. Lowe, A.C. Powell, D.R. Sadoway, J.A. Warren, V.K. Tewary, M.J.M. Krane and K. Rajan, "Materials Informatics: Facilitating the Integration of Data-Driven Materials Research with Education," *JOM* **60**(3):51–52 (March 2008).
6. W. Pongsaksawad and A. Powell, "Phase Field Modeling of Transport-Limited Electrolysis in Solid and Liquid States," *J. Electrochem. Soc.* **154**(6):F122–F133 (June 2007).
7. A. Powell, Y. Shibuta, J. Guyer and C. Becker, "Modeling Electrochemistry in Metallurgical Processes," *JOM* **59**(5):35–43 (May 2007).
8. U. Pal and A. Powell, "Solid Oxide Membrane (SOM) Technology for Electrometallurgy," *JOM* **59**(5):44–49 (May 2007).
9. L.M. Bartolo, S.C. Glotzer, C.S. Lowe, A.C. Powell IV, D.R. Sadoway, J.A. Warren, V.K. Tewary and K. Rajan, "NSF NSDL Materials Digital Library & MSE Education," *J. Mater. Sci. Educ.* **28**(1):21–26 (2006).
10. A. Powell and L. Bartolo, "The Transport Phenomena Archive on the NSDL Materials Digital Library Pathway," *J. Mater. Sci. Educ.* **28**(1):91–97 (2006).
11. B. Zhou and A. Powell, "Phase Field Simulations of Liquid-Liquid Demixing During Immersion Precipitation of Polymeric Membranes in 2D and 3D," *J. Membrane Sci.* **268**(2):150–164 (2006).
12. L. Bartolo, C. Lowe, D. Sadoway, A. Powell and S. Glotzer, "NSDL MatDL: Exploring Digital Library Roles," *D-Lib*, **11**:3 (2005).
13. A. Powell and D. Dussault, "Floating Solids: Combining Phase Field and Fluid-Structure Interactions," *Appl. Numer. Anal. Comp. Math.* **2**(1):157–166 (2005).
14. U. Pal, S. MacDonald, D. Woolley, C. Manning and A. Powell, "Results Demonstrating Techniques for Enhancing Electrochemical Reactions Involving Iron Oxide in Slags and C in Liquid Iron," *Metall. Mater. Trans.* **36B**:209–218 (2005).
15. L. Bartolo, S. Glotzer, J. Khan, A. Powell, D. Sadoway, K. Anderson, "MatDL.org: The Materials Digital Library and the National Science Digital Library Program," *J. Mater. Sci. Educ.* **26**(3):213–218 (2004).

16. L. Bartolo, A. Powell, G. Shreve and V. Tewary, "The NSF NSDL GREEN Digital Library: Green's Functions Research and Education Enhancement Network and Undergraduate Education," *J. Mater. Sci. Educ.* **25**(1):19–24 (2003).
17. A. Powell, D. Dussault "Scaling Laws and Instabilities in Electric Field-Enhanced Smelting and Refining of Steel," *Scand. J. Metall.* **32**:33–36 (2003).
18. L. Bartolo, V. Tewary, G. Shreve, A. Powell and M. Zeng, "NSF-NSDL GREEN Project: A Digital Library Partnership of Academia, Government and Industry," *Issues in Science and Technology Librarianship*, **35** (2002).
19. D. Josell, W. Wallace, J. Warren, D. Wheeler and A. Powell, "Misaligned Flip-Chip Solder Joints: Prediction and Experimental Determination of Force-Displacement Curves," *J. Electr. Packaging* **124**:227-233 (2002).
20. A. Powell, "3-D or not 3-D," *JOM* **54**(1):22–24 (Jan. 2002).
21. A. Powell, P. Minson, G. Trapaga and U. Pal "Mathematical Modeling of Vapor Plume Focusing in Electron Beam Evaporation," *Metall. Mater. Trans.* **32A**:1959–1966 (2001).
22. J. Silver, Z. Mi, K. Takamoto, P. Bungay, J. Brown and A. Powell "Controlled Formation of Low-Volume Liquid Pillars between Plates with a Lattice of Wetting Patches by Use of a Second Immiscible Fluid," *J. Colloid & Interface Sci.* **219**:81–89 (1999).
23. J. Van Den Avyle, J. Brooks and A. Powell "Reducing Defects in Remelting Processes for High-Performance Alloys," *JOM* **50**(3):22–25, 49 (March 1998).
24. A. Powell, J. Van Den Avyle, B. Damkroger, J. Szekely and U. Pal "Analysis of Multicomponent Evaporation in Electron Beam Melting and Refining of Titanium Alloys," *Metall. Mater. Trans.* **38B**, 1227–1239 (1997).

Conference Proceedings and Other Publications

1. A. Powell, "Simulating morphology of electrochemical deposits in shear flow," *TMS 2008 Annual Meeting Supplemental Proceedings Volume 2: Materials Characterization, Computation and Modeling*, p. 287.
2. R. DeLucas, A. Powell and U. Pal, "Boundary Element Modeling of Solid Oxide Membrane Process," *TMS 2008 Annual Meeting Supplemental Proceedings Volume 2: Materials Characterization, Computation and Modeling*, p. 301.
3. S. Pati, R. DeLucas, A. Powell and U. Pal, "Magnesiothermic Reduction of Titanium Oxide Using the Solid Oxide Membrane Process," *Magnesium Technology 2008*, p. 33.

4. A. Powell, "Optimizing Transdermal Drug Delivery Through Diffusion Modeling," *Controlled Release Society Newsletter* **24**(4), pp. 17–19 (December 2007).

5. A. Powell and W. Pongsaksawad, "Phase field modeling of phase boundary motion due to transport-limited electrochemical reactions," in V.G. DeGiorgi, C.A. Brebbia and R.A. Adey eds. *Simulation of Electrochemical Processes II*, WIT Press, May 2007, pp. 43–52.

6. A. Powell and A. Morris, "Wikipedia in Materials Education," in *Internet and Other Electronic Resources for Materials Education* (A. Powell, ed.), TMS, 2007.

7. A. Powell, "The 16th Annual Iketani Conference: Masuko Symposium," *JOM* **59**(2):81–82 (Feb. 2007).

8. A. Powell and W. Pongsaksawad, "Phase Field Modeling of Phase Boundary Shape and Topology Changes Due to Electrochemical Reactions in Solid and Liquid Systems," *Proc. 16th Iketani Conference, Masuko Symposium*, University of Tokyo, November 2006, pp. 793–814.

9. A. Powell, W. Pongsaksawad and U. Pal, "Phase Field Modeling of Phase Boundary Shape and Topology Changes Due to Electrochemical Reactions in Solid and Liquid Systems," in F. Kongoli and R. Reddy eds. *Advanced Processing of Metals and Materials Vol. 3: Thermo and Physicochemical Principles: Special Materials; Aqueous and Electrochemical Processing*, TMS, August 2006, pp. 623–640.

10. M. Suput, R. DeLucas, S. Pati, G. Ye, U. Pal and A. Powell, "Solid Oxide Membrane (SOM) Technology for Environmentally Sound Production of Titanium," in F. Kongoli and R. Reddy eds. *Advanced Processing of Metals and Materials Vol. 4: New, Improved and Existing Technologies: Nonferrous Materials Extraction and Processing*, TMS, August 2006, pp. 273–284.

11. L. Bartolo, S. Glotzer, C. Lowe, A. Powell, K. Rajan, D. Sadoway, J. Warren and V. Tewary, "NSF NSDL Materials Digital Library Pathway & MSE Education," in T.R.. Finlayson, F.M. Goodchild, M.G. Norton and S.R.J. Oliver eds. *Forum on Materials Science Education*, MRS, December 2005, PP2.1.

12. A. Powell, O. Ocholi, J. Vieyra and B. Zhou, "`Illuminator`: a Free Graphics Toolkit for Parallel Visualization of Continuum Field Data," submitted to *Proc. IEEE Cluster 2005*.

13. L. Bartolo, S. Glotzer, J. Khan, A. Powell, D. Sadoway, V. Tewary, J. Warren and K. Anderson, "MatDL.org: The Materials Digital Library and the National Science Digital Library Program," in *Educating Tomorrow's Materials Scientists and Engineers* (K. Chen, M. Falk, T. Finlayson, W. Jones, L.J. Martinez-Miranda eds.), 2004.

14. B. Zhou and A. Powell, "Simulations of Polymeric Membrane Formation by Immersion Precipitation: Liquid-Liquid Demixing," *MRS Symp. Proc.* **790** P7.10 (December, 2003). (Won best poster award)
15. A. Powell and D. Dussault, "Detailed Mathematical Modeling of Liquid Metal Streamer Formation and Breakup," *Proc. Yazawa Symp. 2003 vol. III*, TMS, 235–250.
16. L. Bartolo, A. Powell, G. Shreve and V. Tewary, "The NSF NSDL GREEN Digital Library: Green's Functions Research and Education Enhancement Network," *MRS Symp. Proc.*, **760E** JJ1.7 (December, 2002).
17. D. Dussault and A. Powell, "Phase Field Modeling of Electrolysis in a Slag or Molten Salt," *Proc. Mills Symp.*, The Institute of Materials, London, UK, 359–371 (2002).
18. U. Pal, S. MacDonald, D. Woolley, A. Powell and C. Manning, "Enhancing Electrochemical Reactions in Smelting and Refining Operations," *2001 Electric Furnace Conf. Proc.*, ISS publication, 323–336.
19. A. Powell, "Modeling Alignment Shift of Soldered Optical Fiber," *IEEE Proc. ECTC 2000* 997–1001.
20. A. Powell, Book Review of *Lattice-Gas Cellular Automata: Simple Models of Complex Hydrodynamics* by D. Rothman and S. Zaleski, *Computers in Physics* **12** (6) 576 (1998).
21. A. Powell, J. Warren and C. Bailey, "Mechanism of Motion of an Optical Fiber Aligned by a Solder Droplet," *MRS Symp. Proc.* **531** 95–100 (April 1998).
22. A. Powell, J. Van Den Avyle and U. Pal, "Optimal Beam Pattern to Maximize Inclusion Residence Time in an Electron Beam Melting Hearth," *Proc. AVS Vac. Metall. Conf.* 78–84 (1997).
23. A. Powell, J. Van Den Avyle, B. Damkroger and U. Pal, "Prospects for Titanium Alloy Composition Control by Electron Beam Scan Frequency Manipulation," *Proc. Conf. EBM&R State of the Art 1996* 138–150.
24. P. Minson, A. Powell and G. Trapaga "Theory of Vapor Plume Focusing in Electron Beam Evaporation by the Direct Simulation Monte-Carlo Method," *Proc. Conf. EBM&R State of the Art 1996* 126–137.
25. M. Miszkiel, R. Davis, J. Van Den Avyle and A. Powell "Video Imaging and Thermal Mapping of the Molten Hearth in an Electron Beam Melting Furnace," *Proc. Conf. EBM&R State of the Art 1995* 243–254.
26. U. Jain, A. Powell and L. Hobbs "Simulation of Crystal-to-Amorphous Transition in Irradiated Quartz," *MRS Symp. Proc.* **209** 201–206 (1991).

Invited Presentations

1. A. Powell, L. Bartolo, M. Krane, E. Garcia, L. Li, "Materials and Society Resources on the Teaching Archive of the Materials Digital Library," TMS Annual Meeting, February, 2010.
2. A. Powell, "Solid Oxide Membrane (SOM) Electrolysis of Magnesium and New Process Modeling Software" (in Japanese), University of Tokyo Rare Metals Research Workshop, November 27, 2009.
3. A. Powell, "Thermodynamic and property data for CALPHAD and phase field calculations," Materials Science and Technology, October 27, 2009.
4. A. Powell, "Integrated Computational Materials Engineering," Northeastern University Mechanical and Industrial Engineering Seminar, October 22, 2009.
5. A. Powell, "Consulting and Entrepreneurship: Lessons along the way from a career in progress," Cornell University Seminar in Materials Science and Engineering, September 29, 2009.
6. A. Powell, "An Integrated Open Source Stack for Thermodynamics and Phase Field Simulations," Open Source Tools for Materials Research and Engineering, TMS Annual Meeting 2009, February 19, 2009.
7. A. Powell, "Phase Field Modeling of Polymer Membrane Structure Formation" (in Japanese), Sekisui Corporation (Tokyo, Japan), December 8, 2008.
8. A. Powell, "New Opportunities for Materials Development Using Integrated Computational Materials Engineering (ICME)," and "Phase Field Modeling of Phase Boundary Motion Due to Transport-Limited Electrochemical Reactions," Materials Engineering Seminar Series, Hanyang University (Seoul, Korea), December 4–5, 2008.
9. A. Powell, "Integrated Computational Materials Engineering (ICME)" (in Japanese), Nippon Steel Research and Engineering Center Lecture (Futtsu, Japan), December 3, 2008.
10. A. Powell, "An Open Source Stack for Integrated Computational Materials Engineering (ICME)," Mechanical Engineering Seminar, University of Maryland Baltimore County, October 17, 2008.
11. A. Powell, "Multiscale Modeling of Waveform Design for Fast Stable Electrodeposition," Materials Science & Technology 2008, Discovery and Optimization of Materials Through Computational Design Symposium, October 9, 2008.
12. A. Powell, "Online Materials Education Communities: Transforming More Than Just Content Delivery," International Organization of Materials, Metals & Minerals Societies (IOMMMS) Global Materials Forum 2008, March 10, 2008.

13. A. Powell, "New Opportunities for Materials Development Using Integrated Computational Materials Engineering (ICME)," IDGA 7th Annual Next Generation Materials for Defense Conference, December 12, 2007.
14. A. Powell, "End-to-End Modeling of Polymer Membranes for Water Filtration and Material Recycling Technologies," Columbia University, April 27, 2007.
15. A. Powell and W. Pongsaksawad, "Detailed Phase Field Modeling of Dendrite and Sponge Formation in Mixed Solid/Liquid Systems," TMS Annual Meeting, Innovations in Electrometallurgy Symposium, February 28, 2007.
16. A. Powell, "Solid Oxide Electrolytes for Metal Smelting and Fuel Cells," Thailand National Metals and Materials Technology Center, November 21, 2006.
17. A. Powell, "`Julian`: a Flexible Tool Kit for Boundary Element Method Simulations," Thailand National Metals and Materials Technology Center, November 21, 2006.
18. A. Powell, W. Pongsaksawad and U. Pal, "Phase Field Modeling of Phase Boundary Shape and Topology Changes Due to Electrochemical Reactions in Solid and Liquid Systems," TMS Sohn Symposium, August 30, 2006.
19. A. Powell, "Modeling Structure Formation in Polymer Membranes for Water Filtration and Collagen Tissue Engineering Scaffolds," Rensselaer Polytechnic Institute, March 29, 2006.
20. A. Powell, "Abstract Title: Mixed Stress: An Approach to Mixing Fluids and Solids in Phase Field Models," TMS Annual Meeting Computational Thermodynamics and Phase Transformations Symposium, March 15, 2006.
21. A. Powell, "Thermodynamics-Based Modeling of Phase Boundary Motion in Reactive Metal Processing," JSPS Core-to-Core Reactive Metals Workshop, MIT, March 17, 2006.
22. A. Powell, "Phase Field Modeling of Materials Microstructure Formation and Evolution," University of Massachusetts at Amherst, March 9, 2006.
23. A. Powell, "Modeling Structure Formation in Polymer Membranes for Water Filtration and Collagen Tissue Engineering Scaffolds," University of Massachusetts at Amherst, February 1, 2006.
24. A. Powell, "Phase Field Modeling of Liquid-Liquid Demixing During Immersion Precipitation Casting of Polymer Membranes," Rohm & Haas Electronic Materials, October 25, 2005.
25. A. Powell, "Phase Field Modeling of Liquid-Liquid Demixing During Immersion Precipitation Casting of Polymer Membranes," Tufts University, October 24, 2005.

26. A. Powell, "Phase Field Modeling of Phase Boundary Motion Due to Transport-Limited Electrochemical Reactions," Columbia University, October 7, 2005.
27. A. Powell, "Phase Field Modeling of Phase Boundary Motion Due to Transport-Limited Electrochemical Reactions," Pohang University of Science and Technology, September 21, 2005.
28. A. Powell, "Phase Field Modeling of Phase Boundary Motion Due to Transport-Limited Electrochemical Reactions" (in Japanese), University of Tokyo Nanoionics Workshop, Aizu, Japan, September 16, 2005.
29. A. Powell, "Phase Field and Transport: New Twists on a Mesoscale Structure Modeling Technique," MIT Research in DMSE Lecture Series, April 1, 2005.
30. A. Powell, "RheoPlast: Open-Source Parallel Finite Difference Phase Field Software" (in Japanese), University of Tokyo, Japan, March 23, 2005.
31. A. Powell, "Phase Field and Transport: New Twists on a Mesoscale Structure Modeling Technique," MIT Materials Day, October 19, 2004.
32. A. Powell, "Phase Field Modeling of Liquid-Liquid Demixing During Immersion Precipitation Casting of Polymer Membranes," Tufts University Mechanical Engineering Seminar Series, September 23, 2004.
33. A. Powell, "Phase Field Modeling of High Temperature Electrochemistry" (in Japanese), University of Tokyo, Japan, July 30, 2004.
34. A. Powell, "Introduction to Modeling and Simulation: a Multidisciplinary Approach to Computational Materials Education," MRS Spring Meeting, San Francisco, California, April, 2004.
35. A. Powell, "Transport Education in the Materials Curriculum: Innovative Approaches, Exercises, and New Challenges," TMS Annual Meeting, Charlotte, North Carolina, March 17, 2004.
36. W. Pongsaksawad and A. Powell, "A Phase-Field Model of the Cathode Interface in Transport-Limited Metal Reduction and Refining Processes," TMS Annual Meeting, Charlotte, North Carolina, March 17, 2004.
37. A. Powell, "Computational Materials at MIT" (in Japanese), University of Tokyo, Japan, January 9, 2004.
38. A. Powell, "New directions in phase field modeling of morphology evolution across a wide variety of materials," University of Tokyo/MIT/Cambridge University Collaboration in Materials Science and Engineering, Cambridge, Massachusetts, December 4, 2003.
39. A. Powell, "New Tools for Cold Hearth Process Modeling," Specialty Metals Producers Consortium Workshop, Cleveland, Ohio, June 25, 2003.

40. A. Powell, "Modeling Fluid-Structure Interactions in Dendritic and Faceted Crystal Solidification," Northwestern University Distinguished Minority Scholars Seminar, Evanston, Illinois, April 2, 2003.
41. A. Powell and D. Dussault, "Detailed Mathematical Modeling of Liquid Metal Streamer Formation and Breakup," TMS Annual Meeting, San Diego, California, March 4, 2003.
42. A. Powell and S. Yip, "Introduction to Modeling and Simulation: a Multidisciplinary Approach to Computational Materials Education," TMS Annual Meeting, San Diego, California, March 4, 2003.
43. A. Powell, "Modeling Solidification of Crystals Floating in a Moving Liquid," Purdue University Materials Seminar, West Lafayette, Indiana, December 3, 2002.
44. A. Powell, "Modeling Solidification of Crystals Floating in a Moving Liquid," MIT Mechanical Engineering Mechanics and Materials Seminar, December 2, 2002.
45. A. Powell, "Coupling Phase Transformations and Fluid-Structure Interactions," Aerodyne Research, Inc., Billerica, Massachusetts, November 13, 2002.
46. A. Powell, "The Julian Boundary Element Code," NIST Green's Functions Experts Workshop, Boulder, Colorado, March 25, 2002.
47. A. Powell "Solder Wetting and Solidification: Implications for Passive Alignment," MIT Microphotonics Center, March 13, 2002.
48. A. Powell "Green's Functions, Boundary Elements and Julian," National Educators' Workshop, College Park, Maryland, October 15, 2001.
49. A. Powell "Scaling Laws and Instabilities in Electric Field Enhanced Smelting and Refining of Steel," Sixth International Conference on Molten Slags, Fluxes and Salts, Stockholm, Sweden, June 15, 2000.
50. A. Powell "Modeling Shift of a Solder-Aligned Optical Fiber," TMS Annual Meeting, San Diego, California, March 1, 1999.

Software

Author of several open-source software codes for research and education:

`RheoPlast` 2-D and 3-D parallel finite difference multi-physics code for phase field modeling with modules for binary and ternary polymer thermodynamics, crystal solidification, heat conduction, fluid-structure interactions, and electrochemical reactions.

`Julian` boundary element library for mechanics and heat transfer modeling with matrix partitioning for rapid re-solution on small changes to the mesh.

`Ternary` phase diagram calculation software, soon to become `Gibbs` multi-component phase diagram calculation software.

`BlobStats` GIMP plug-in for calculating and reporting statistics on "blobs" in material microstructure images.

`castabox` 3-D parallel heat conduction courseware illustrating principles of casting.

`EBaporate` Estimates evaporation kinetics due to a scanning electron beam.

`Plumage` Direct Simulation Monte Carlo code used to calculate vapor plume distribution in electron beam or laser evaporation.

`Sphlow` Java applet calculates terminal velocity of a rising/sinking sphere at Reynolds numbers up to 10^5, and estimates neutral density window for flotation processes such as a tundish or hearth melting operation.

`Illuminator` distributed visualization library for parallel rendering and storage of 3-D finite difference data.

Pedagogy

Courses Taught

Spring semester 2009 Developer and lead instructor for *Materials Processing* Boston University Mechanical Engineering undergraduate requirement for Manufacturing program.

Spring semester 2008 Developer and lead instructor for *Transport Phenomena in Materials Engineering* Boston University Manufacturing Engineering graduate elective.

Spring semesters 2005–2006 developer and lead instructor for *Materials Processing* department core undergraduate introduction to engineering of materials processing operations with a focus on structure formation.

Spring semesters 2000, 2002–2006 four to six lectures in *Kinetic Processes in Materials* department core graduate course, my lectures focusing on the role of fluid phenomena in kinetic processes.

Spring semesters 2002–2006 developer and co-leader of *Introduction to Modeling and Simulation* multidisciplinary undergraduate course involving 8-10 faculty from 5-7 departments.

Fall semesters 1999–2003 lead instructor for *Transport Phenomena in Materials Engineering* department core undergraduate introduction to fluid dynamics and heat and mass transfer.

Spring semesters 2000–2001 lead instructor for *Materials Processing* graduate case studies in engineering of materials processing operations.

Other Pedagogy Activities

Co-founder of the Green's Functions Research and Education Enhancement Network (GREEN) NSDL Digital Library, contributed tutorial materials on Green's functions and boundary elements, `Julian` boundary element library, Green's Functions Markup Language (GreenML), `Illuminator` Distributed Visualization Library.

Co-founder of the Materials Digital Library `MatDL.org`, contributed student work from Introduction to Modeling and Simulation and materials in the *Transport Phenomena Archive*.

Founder of the *Transport Phenomena Archive*, an online space for collaborative development of readings, handouts, exercises with solutions, courseware, and other educational resources related to transport phenomena, with an initial focus on materials processing and performance. Contributed 66 homework problems, four documents on pedagogy, two extensive readings, two educational computer programs, and nine other resources to the Archive.

Publicly accessible syllabi, notes, homework assignments, exams, solutions from MIT subject *Transport Phenomena in Materials Engineering*, 1994 and 1999-2003.

Publicly accessible syllabi, notes, homework assignments, exams, solutions from MIT subject *Materials Processing*, 2005.

Service

Professional Society Committees

TMS Extraction and Processing Division Continuing Education Chair 2008–present, Materials and Society Committee Representative 2009–present.

TMS Technology@TMS Technical Advisory Group Member 2006–present.

TMS Integrated Computational Materials Engineering Technical Advisory Group (ICME TAG) Member 2005–present.

TMS Education Committee Chair 2007–2009, Information Technology Committee Liaison 2005–2007, Member 2002–present.

TMS Process Technology and Modeling Committee, TMS (formed by merger of the Process Fundamentals and Process Modeling, Analysis and Control Committees) Member 2006–present.

TMS Process Fundamentals Committee Chair 2004–2006, Program Chair 2002–2004, Member 2001–2006.

TMS Process Modeling, Analysis and Control Committee Chair 2003–2005, Vice Chair 2001–2003, Member 2000–2006.

Symposia Organized

Co-Chair February 2009, *Open Source Tools for Materials Engineering and Research* Symposium, TMS Annual Meeting.

Chair October 2008, *Powering Up Massachusetts' Sustainable Energy Industry*, North Shore Technology Council Forum.

Co-Chair March 2008, *Frontiers in Process Modeling* Symposium, TMS Annual Meeting.

Chair February 2007, *Internet and Other Electronic Resources for Materials Education* Symposium, TMS Annual Meeting.

Co-Chair February 2007, *Innovations in Electrometallurgy* Symposium, TMS Annual Meeting.

Organizing Committee August 2006, *Sohn International Symposium on Advanced Processing of Metals and Materials*, TMS.

Chair March 2003, March 2004; Co-Chair March 2001, February 2005, March 2006; *Materials Processing Fundamentals* Symposium, TMS Annual Meeting.

Chair March 2004, *Teaching Transport in Materials Education* Symposium, TMS Annual Meeting.

Co-Chair March 2003, *Electrochemical Measurements and Processes* Symposium, TMS Annual Meeting.

Professional Society Membership

American Society for Engineering Education (ASEE)

Materials Research Society (MRS)

Minerals, Metals and Materials Society (TMS)

Proposal Review

February-March 2007: National Science Foundation: Inorganic Chemistry review panel participant.

November 2006: National Science Foundation: Membranes (CAREER, unsolicited) review panel participant.

March 2005: National Science Foundation: Nanoscale Interdisciplinary Research Team (NIRT) review panel participant.

August 2003: National Science Foundation: Course, Curriculum and Laboratory Improvement (CCLI) review panel participant.

MIT Committees and Undergraduate Advising

Department of Materials Science and Engineering Undergraduate Committee April 2000–June 2006.

MIT Taskforce on Minority Student Achievement May 2000–December 2002.

Undergraduate academic advisor: 13 in class of 2001 June 2000–June 2001; 19 in class of 2004 May 2001–June 2004; 5 freshmen in class of 2005 August 2001–May 2002; 16 in class of 2007 January 2004–June 2006.