

## **KATAYUN (KATY) BARMAK**

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### **EDUCATION**

Ph.D., Materials Science, Massachusetts Institute of Technology, 1989  
M.A., University of Cambridge, England, 1987  
S.M., Metallurgy, Massachusetts Institute of Technology, 1985  
B.A., Materials Science, 1st Class Honours, University of Cambridge, England, 1983

### **PROFESSIONAL EXPERIENCE**

2013-present      Director, Materials Science and Engineering Program,  
Dept. of Applied Physics and Applied Mathematics, Columbia University

2011-present      Philips Electronics Professor of Applied Physics and Applied Mathematics  
and Materials Science and Engineering, Columbia University

2002-2011      Full Professor with indefinite tenure, Carnegie Mellon University

1999-2002      Associate Professor with indefinite tenure, Carnegie Mellon University

1997-1998      Associate Professor with indefinite tenure, Lehigh University

1995-1998      Co-director, Thin Film Laboratory, Materials Research Center, Lehigh

1992-1997      Assistant Professor, Lehigh University

1989-1992      Staff Engineer, Advanced Device Development, IBM T. J. Watson  
Research Center and IBM East Fishkill, New York.  
R&D of materials, processes and structures for advanced generations  
of bipolar junction and field effect transistors

### **HONORS AND AWARDS**

2010-2013      International Materials Review Committee Member

2009      Philbrook Prize in Engineering awarded for substantial, sustained  
contributions to excellence in education, or to the application of materials  
science to important problems, Department of Materials Science and  
Engineering, Carnegie Mellon University

2004 IBM Materials Research Community Visiting Scientist, IBM T. J. Watson Research Center (one of only two faculty awards made worldwide)

1998-2003 Visiting Scientist, IBM T.J. Watson Research Center

2001 NSF Creativity Award

1999 Meeting Chair, Materials Research Society, Spring 1999

1999 IBM Faculty Fellowship Award

1998-2000 Materials Research Society Council, elected member

1995 Alfred Noble Robinson Award, Recognizing outstanding performance in the service of the university and unusual promise of professional achievement, Lehigh University

1994 National Young Investigator (NYI) Award, National Science Foundation

1994 Deutsche Forschungsgemeinschaft Fellowship  
Institute of Materials, GKSS Research Center, Geesthacht, Germany

1992-1993 Harold Chambers Junior Faculty Chair of Materials Science and Engineering, Lehigh University

1986-1989 AT&T Foundation Fellowship

1985 Elected to Sigma Xi, Science Honor Society

1983 New Hall Prize for academic excellence, University of Cambridge

1981-1983 Posener Academic Scholarship, New Hall, University of Cambridge

## **MEMBERSHIP OF PROFESSIONAL SOCIETIES**

IEEE, Materials Research Society (MRS); American Physical Society (APS), The Minerals, Metals, Materials Society (TMS); ASM International (ASM), Microscopy Society of America (MSA); Microbeam Analysis Society (MAS); American Association for the Advancement of Science (AAAS); New York Academy of Science (NYAS); American Society for Engineering Education (ASEE), Sigma Xi

## **TEACHING EXPERIENCE**

### **Columbia University**

MSAE E4100 ( <i>New</i> )	Crystallography (F13, F14, F15)
MSAE E4101	Structural Analysis of Materials (F13, F14)
MSAE E4215	Mechanical Behavior of Materials (S13, S14)
MSAE E4201 ( <i>New</i> )	Materials Thermodynamics and Phase Diagrams (S16)

### **Carnegie Mellon University**

#### Undergraduate Courses

27-100	Materials in Engineering (F99, S00, F00, S05, S06)
27-202 ( <i>New</i> )	Defects in Materials (F01, F03)
27-217 ( <i>New</i> )	Phase Relations and Diagrams (S01, S07, S08, S09)

27-302 ( <i>New</i> )	S10) Microstructure and Properties II (F03, F04, S06, S07)
27-530 ( <i>New</i> )	Advanced Physical Metallurgy (S00)

#### Graduate Courses

27-780 ( <i>New</i> )	Thermodynamics (F08)
27-799 ( <i>New</i> )	Thermodynamics II (F09, F10)
39-610 ( <i>New</i> )	Energy Conversion and Supply (F10)

#### Non-FCE Courses

27-401	Senior Design Class (Supervised student project)
27-774	Graduate Seminar (F06, S07, F07, S08, F08, S09)

### **Lehigh University**

#### Undergraduate Courses

MAT33	Engineering Materials and Processes (S94, S95, S97, F97×2 (taught two sections), S98)
MAT216	Diffusion and Phase Transformations (F96, F97)
MAT312, ChE312, CHM312( <i>New</i> )	Fundamentals of Corrosion (S93, S95, S97)
MAT367, ChE367 ( <i>New</i> )	Metal Films and Coatings: Processing, Structure, Properties (Co-taught with Chemical Eng.) (S94)

#### Graduate Courses

MAT401 ( <i>New</i> )	Thermodynamics and Kinetics I (F93, F94, F95)
MAT412 ( <i>New</i> )	Magnetic Properties of Materials (F93)

#### Laboratories

Renovated, set up and upgraded an undergraduate x-ray diffraction laboratory in Whitaker.

#### Short Courses and Other

Lehigh Microscopy Short Course	Scanning electron microscopy laboratories (S93, S94, S95, S96)
Guest lecture, Engineering 1 - (Undergraduate)	Engineering Computations (F96)
Guest lectures on thin film reactions MAT408 (Graduate)	Phase Transformations (F96)

*For courses marked as “New”, I developed notes, problem sets, examinations and team projects depending on the content of the course.*

## RESEARCH INTERESTS

Processing, properties, crystal structure, grain structure, and texture of polycrystalline metal films for application in engineered systems such as integrated circuits and magnetic recording media; thermodynamics and kinetics of reactions and phase transformations in nanostructured films; experimental, analytical and simulational studies of transformations and associated microstructures in thin films; and properties of grain boundaries. Characterization techniques of interest include differential scanning calorimetry (DSC), x-ray and electron diffraction (XRD, ED), and transmission, scanning and orientation imaging microscopy (TEM, SEM, OIM). My group has been an internationally recognized for the use of differential scanning calorimetry in quantitative kinetic and thermodynamic studies solid state reactions and phase transformations in thin films.

## RESEARCH PROGRAM FUNDING

47. PI, LAM Research Corporation, unrestricted gift, \$40,000 (6/9/2014).
46. PI, REU Supplement, Collaborative Research: Towards Rare-Earth-Free Advanced Permanent Magnets – High-Anisotropy  $L1_0$  Materials”, NSF CMMI-1259736, \$10,000 (04/14/2014-08/31/2014).
45. Co-PI, “Ultrathin Intermetallic Phases for Giant Spin Hall Effect”, NSF DMR-1411160, \$419,994, (9/1/2014-8/31/2017). PI: William Bailey.
44. Co-PI, “Co, Ni, Ru and W as Alternate Interconnects for sub-30 nm Linewidths”, Global Research Corporation/Semiconductor Research Corporation, TEL Customization funding, SRC 2323.001, \$271,000 (7/1/12-12/31/14). Co-PI: Kevin R. Coffey (UCF).
43. Co-PI: “Oriented, single-crystal nanowires for mitigation of classical resistivity size effect: A theoretical investigation”, Semiconductor Research Corporation, \$0/\$40,000 (10/1/12-12/31/14). PI: Patrick Schelling, Co-PI: Kevin R. Coffey (UCF).
42. Co-PI, “Multiscale Development of  $L1_0$  Materials for Rare-Earth-Free Permanent Magnets”, ARPA-E REACT Grant # 0472-1537, \$245,000/2,800,000 (11/1/11-09/30/2013). PI: Laura H. Lewis (NEU), other Co-PIs: Vincent Harris (NEU), Jeffrey E. Shield, Ralph. Skomski (UNL), Joseph. Goldstein (UMass, Amherst), Frederick Pinkerton (GM), Steven Constandinidis (Arnold Magnetics)
41. Co-PI: Collaborative Research: Towards Rare-Earth-Free Advanced Permanent Magnets – High-Anisotropy  $L1_0$  Materials”, NSF CMMI-1129313, \$159,041/465,900 (9/1/11-8/31/14). Co-PIs: Laura. H. Lewis (NEU), Jeffrey E. Shield (UNL).
40. PI, “High Throughput Electron and X-ray Diffraction Based Metrology of Nanocrystalline Materials”, Global Research Corporation/Semiconductor Research Corporation, SRC 2121.001, \$300,000 (2/1/11-1/31/14). Co-PI: Kevin R. Coffey (UCF).

39. PI, "Quantitative Kinetic Experiments and Models of L<sub>10</sub> Formation in FePt, CoPt and Related Alloy Films", Information Storage Industry Consortium, Extremely High Density Recording Program, \$35,000 (1/1/10-12/31/10), \$17,500 (1/1/11-5/31/11).
38. Co-PI, "Electron Microscopy of Hard Coatings and Other Tool Materials", Kennametal Inc., \$164,000 (02/01/09-01/31/11). PI: Paul Salvador (CMU).
37. PI, "Automated, Quantitative Microstructural Characterization of Nanometric Metals", Intel, \$28,000 (2/1/09-12/31/09).
36. PI, "The A1 to L<sub>10</sub> Transformation in FePt Films with Ternary Alloying Additions", NSF DMR-0804765, \$330,000 (7/1/08-6/30/12).
35. PI, "Thermodynamics and Kinetics of the A1 to L<sub>10</sub> Transformation in FePt and Related Ternary Alloys for Ultrahigh Density (1 Tb/in<sup>2</sup>) Magnetic Recording Media: Differential Scanning Calorimetry", Seagate Technology/DSSC, \$68,000 (01/01/08-12/31/08).
34. Co-PI, "Ordered Intermetallics for Ultrahigh Density Hard Disk Drives (HDD) and for Microelectromechanical Systems (MEMS)", PITA, \$23,898 (09/01/06-05/31/08). Co-PI: Gary Fedder (CMU).
33. Co-PI, "Electron Microscopy of Hard Coatings and Other Tool Materials", Kennametal Inc., \$140,000 (8/1/06-7/31/08). Co-PI: P. Salvador (CMU).
32. PI, "Thermodynamics and Kinetics of the A1 to L<sub>10</sub> Transformation in FePt and Related Ternary Alloys for Ultrahigh Density (1 Tb/in<sup>2</sup>) Magnetic Recording Media: Differential Scanning Calorimetry", Seagate Technology, \$79,792 (09/01/06-08/31/07).
31. PI, "Resistivity of Cu Interconnects: Grain Growth in Films and Lines", Intel, \$70,000, (7/1/06-6/31/08).
30. Co-PI, "Reaction Kinetics of Nickel with Pb-free Sn-Bi-In-Zn-Sb Solders", US CRDF, \$75,900 (of which \$15,180 is Subcontract to CMU) (03/01/06-02/29/08). PI: Vasyly Dybkov, Institute for Problems of Materials Science, Kyiv, Ukraine.
29. Co-PI, "Carnegie Mellon Materials Research Science and Engineering Center", NSF DMR-0520425, \$6,500,000 (9/1/05-8/31/11). PI: Gregory S. Rohrer (UCF).
28. PI, "The A1 to L<sub>10</sub> Transformation in FePt, CoPt and Related Ternary Alloy Films", NSF DMR-0506374, \$285,000 (7/1/05-6/30/08).
27. Co-PI, "Electrical Resistivity of Sub-45nm Interconnects: The Classical Size Effect", Semiconductor Research Corporation Task 4212.008, \$330,000 (\$154,153 Subcontract CMU) (02/01/05-01/31/08). PI: Kevin R. Coffey (UCF).
26. Co-PI, "Lab Facilities Computing Upgrade", Intel Corporation \$46,101, (06/05). PI: Robert

Heard (CMU).

25. PI, “Calorimetric Studies of Single- and Multi-Layer Thin Films in Recording Technology” Seagate \$70,000, (7/1/03-6/31/04).

24. PI, “Calorimetric Studies of Single- and Multi-Layer Thin Films in Recording Technology” Seagate \$62,000, (7/1/02-6/31/03).

23. Co-PI, “Silicide quantum dots for nanoelectronics”, NSF ECS-0210647, \$89,871 (7/15/02-1/14/04). PI: David Greve (CMU).

22. Co-PI, “Impact of dislocations on a phase transformation: simulation of microstructural evolution”, PTIA, \$55,500 (9/01-12/02), Collaborator, Jeffrey Rickman (Lehigh University).

21. Co-PI, “Magnetic Tunnel Junctions for the Magnetic Random Access Memory”, Pennsylvania Digital Greenhouse, \$300,000, (9/01-8/04), PI: Robert White. Other Co-PIs: Jiangang Zhu, and Robert Hoburg (CMU).

20. PI, “Calorimetric Studies of Single- and Multi-Layer Thin Films in Recording Technology”, Seagate \$55,000, (7/01-6/02).

19. PI, “Creativity Award – Microstructure Evolution in Thin Film: Cu alloys and microcalorimetry, NSF DMR-9996315, \$224,793 (9/01-8/03).

18. PI, “Calorimetric Studies of Single- and Multi-Layer Thin Films in Recording Technology” Seagate \$57,000, (7/00-6/01).

17. PI, “Magnetic Properties of L1<sub>0</sub> Alloys”, Data Storage Systems Center, Carnegie Mellon University, \$80,000, (9/00-8/01).

16. Co-PI, “Materials Research Science and Engineering Center”, NSF DMR-0079996, \$4,300,000, (9/00–8/05). PI: Gregory Rohrer, other Co-PI’s: Brent L. Adams, David Cassasent, David Kinderlehrer, Anthony D. Rollett, Robert Suter, Shlomo Ta’asan (CMU).

15. Co-PI, “Development of Equipment for Fabrication of Quantum Cellular Automata”, NSF ECS-0079485, \$209,867, CMU cost sharing \$100,000, (9/00-8/01). PI: David Greve.

14. Co-PI, “Collaborative to Integrate Research and Education (CIRE)” with Florida A&M University (FAMU), Co-PI, NSF, \$150,748 (sub-contract from FAMU), (9/99-8/02). PI: H. Garmestani (FAMU).

13. Co-PI (starting in 1999), National Science Foundation, “Materials Research Science and Engineering Center – Mesoscale Interface Mapping Project”, \$3,567,000, (5 yrs, 9/96-8/00), PI: Brent L. Adams, David Cassasent, David Kinderlehrer, Anthony D. Rollett, Robert Suter, Shlomo Ta’asan (CMU).

12. PI, IBM, "University Partnership Program", \$40,000, (1 yr, 9/99-8/00).
11. Co-PI, Sandia National Laboratory, "Automated Analysis of Electron Micrographs)", \$20,989 (3 mos., 7/98-9/98). Co-PI: Jeffrey M. Rickman (Lehigh).
10. PI, National Science Foundation (NSF), DMR-9713439 Amendment, "REU - "Evolution of grain structure in thin film reactions", \$5000 (0.5 years, 3/98-10/98). Co-PI: Jeffrey M. Rickman (Lehigh).
9. PI, National Science Foundation (NSF), DMR-9713439, "Evolution of grain structure in thin film reactions", \$369,706 (4 years, 11/97-10/01). Co-PI: Jeffrey M. Rickman (Lehigh).
8. Co-PI, National Science Foundation (NSF), DMR-9626279, "Acquisition of an automated digital transmission electron microscope", \$709,300 (2 years, 8/96-7/98) and \$450,000 matching funds from Lehigh University. PI: David A. Smith. Co-PIs: Katy Barmak, Helen M. Chan, Charles E. Lyman, Jeffrey. M. Rickman, and David B. Williams (Lehigh).
7. PI, Brookhaven National Laboratory (BNL) 725057, primary contract Department of Energy (DoE) New Initiative DE-AC02-76CH00016, "Magnetic exchange coupling in layered thin-film composites of hard and soft ferromagnets: role of processing and structure", \$125,643 (2/96 – 7/00)
6. Co-PI, Department of Energy (DoE), "Environmental scanning electron microscope - Research Instrumentation Grant", \$245,120 and \$91,800 matching funds from Industry and Lehigh University (1/95-6/97). PI: A. Marder. Other Co-PIs: Katy Barmak, and David B. Williams (Lehigh).
5. PI, National Science Foundation (NSF), DMR-9458000, National Young Investigator award (NYI), \$500,000 (5 years, 9/94-8/00) ) and the following matching funds from companies.
  - Hoeganaes, \$27,000 (1998-99)
  - TA Instruments, \$50,000 (1997)
  - AMP, Inc. \$22,000 (1996)
  - Perkin Elmer \$9631 (1996)
  - Penkem, Inc. \$45,000 (1995)
  - Tencor, Inc. \$55,225 (1994)
  - TA Instruments, Inc. \$7048 (1994)
  - IBM, \$5000 (1994)
4. PI, National Science Foundation (NSF), DMR-9411146, "Acquisition of an ultrahigh vacuum sputtering system for the preparation of nanostructured metal films", \$196,450 (2 years, 6/94-11/96), and \$125,000 matching funds from Lehigh University.
3. PI, National Science Foundation (NSF), DMR-9308651, "Role of grain structure and grain boundary diffusion in thin film reactions", \$238,000 (3 years, 12/93-5/97).
2. Co-PI, National Science Foundation (NSF), DMR-9256332, "Graduate research traineeship in

Materials Science and Engineering", \$555,000 (5 years, 7/93-6/98). PI: David B. Williams. Co-PIs - Katy Barmak, Helen M. Chan, Martin P. Harmer, and Arnold M. Marder.

1. Co-PI, Department of Energy (DoE), DE-93-01-SR010, "Functionally gradient materials for thermal barrier coatings in advanced gas turbine systems, \$750,000 (3 years, 9/93-8/96). PI: A. R. Marder. Other Co-PIs: Helen M. Chan, and Martin P. Harmer (Lehigh).

## **PATENTS, PROVISIONAL PATENTS and DISCLOSURES**

4. **U.S. Patent 9,117,821** - Oriented Crystal Nanowire Interconnects  
Inventors: Barmak, Katayun, Choi, Dooho, Coffey, Kevin R.

3. Thin-Film Media Structures for Perpendicular Magnetic Recording and Storage Devices Made Herewith

- U.S. Nonprovisional Application No. 14/346,247; Filed: 3/20/2014, U.S. National Phase of PCT/US2012/05671, CMU Ref. Nos. 2012-031 and 2012-12, Inventors: Granz, Steven D., Barmak, Katayun, Kryder, Mark H. (Response to final office action 3/26/2015)

2. Rare Earth-Free Permanent Magnetic Material

- International patent PCT/US2012/046935 filed on 7/16/2012. Inventors: Barmak, Katayun, Lewis, Laura, Shield, Jeffrey.

1. **US Patent 6,846,734** - Method and process to make multiple-threshold metal gates CMOS technology

- Inventors: Amos, Ricky; Barmak, Katayun; Boyd, Diane C.; Cabral, Jr., Cyril; Leong, Meikei; Kanarsky, Thomas S.; Kedzierski, Jakub Tadeusz

## **BOOKS and BOOK CHAPTERS**

5. Orientation Mapping, A. D. Rollett and K. Barmak, Chapter in Physical Metallurgy, eds. D. Laughlin, K. Hono, Elsevier, 2014. Print Book ISBN: 9780444537706, eBook ISBN: 9780444537713

4. Metallic Films for Electronic, Magnetic, Optical and Thermal Applications: Structure, Processing and Properties, eds. K. Barmak, K. R. Coffey, Woodhead Publishing Ltd. (now Elsevier), 2014.

ISBN 978-0-85709-057-7 (print)  
ISBN 978-0-85709-629-6 (online)

- 3 Chapters by Barmak
  - Crystal Orientation Mapping in Scanning and Transmission Electron Microscopes
  - Post-Deposition Grain Growth in Metallic Films
  - Disorder-order Transformations in Metallic Films



3. Hollow-cone dark-field transmission electron microscopy for grain size and dislocation-density quantification of nanocrystalline materials, B. Yao, H. Heinrich, K. Barmak, K. R. Coffey, Kyu Cho, and Y.H. Sohn, in "Microscopy: Science, Technology, Applications and Education, A. Méndez-Vilas, and J. Díaz (Eds), , (Formatex Research Center, Badajoz, Spain, 2010). Vol. 2, pp. 1319-1326. ISBN (13): 978-84-614-6190-5

2. Magnetic Ultrathin Films, Multilayers and Surfaces - 1997, eds. J. Tobin, D. Chambliss, D. Kubinski, K. Barmak, P. Dederichs, W. de Jonge, T. Katayama, A. Schuhl, Materials Research Society Symposium Proceedings **475** (1997) pp. 1-622.

1. Polycrystalline Thin Films: Structure, Texture, Properties and Applications, eds. K. Barmak, M. A. Parker, J. A. Floro, R. Sinclair, D. A. Smith, Materials Research Society Symposium Proceedings **343** (1994) pp. 1-772.

## **PUBLICATIONS IN ARCHIVAL JOURNALS**

**Researcher ID: A-9804-2008**

**H-Index: 30 33 (Google)**

**i10 Index 94**

143. J. Liu, M. Rezaeeyazdi, L. Riddiford, C. Floristean, F. Goncalves-Neto, L. H. Lewis, K. Barmak, "Order-disorder transformation kinetics of FeNi<sub>3</sub>", in preparation.

142. K. Barmak, X. Liu, A. Darbal, D. Choi, N. T. Nuhfer, T. Sun, A. P. Warren, K. R. Coffey, M. F. Toney, "On increased twin density and resistivity of Ta<sub>38</sub>Si<sub>14</sub>N<sub>48</sub>-encapsulated nanometric Cu films", in preparation.

141. G. Rohrer, X. Liu, A. P. Warren, N. T. Nuhfer, A. Darbal, K. R. Coffey, J. Liu, K. Barmak, "The grain boundary character distribution of a highly twinned nanocrystalline aluminum thin film compared to bulk microcrystalline aluminum", in preparation.

140. Ana Maria Montes-Arango, Luke G. Marshall, A. D. Fortes, Nina Bordeaux, Sean Langridge, Katayun Barmak, Laura H. Lewis, "Discovery of Process-Induced Tetragonality in Equiatomic FeNi", Acta Mater., submitted for publication.

139. N. Bordeaux, A. M. Montes-Arango, J. Liu, K. Barmak, L. H. Lewis "Thermodynamic and kinetic parameters of the chemical order-disorder transformation in L1<sub>0</sub> FeNi (tetraenaite)", Acta Mater. **103**, 608-615 (2016).

DOI: <http://dx.doi.org/10.1016/j.actamat.2015.10.042>

138. J. Liu, K. Barmak, "Topologically close-packed phases: Deposition and formation mechanism of metastable β-W in thin films", Acta Mater. **103**, 223-227 (2016).

DOI: <http://dx.doi.org/10.1016/j.actamat.2015.11.049>

137. A. M. Montes-Arango, N. Bordeaux, J. Liu, K. Barmak, L. H. Lewis, "L1<sub>0</sub> phase formation in ternary FePdNi alloys", J. Alloys and Compounds **648**, 845-852 (2015).

DOI: <http://dx.doi.org/10.1016/j.jallcom.2015.07.019>

136. Eric Poirier, Frederick E. Pinkerton, Robert Kubic, Raja K. Mishra, Nina Bordeaux, Arif Mubarak, Laura H. Lewis, Joseph I. Goldstein, Ralph Skomski and Katayun Barmak, "Intrinsic magnetic properties of L1<sub>0</sub> FeNi obtained from meteorite NWA 6259", *J. Appl. Phys.* **117**, 17E318 (2015).

DOI: <http://dx.doi.org/10.1063/1.4916190>

135. J. Liu, K. Barmak, "Method for measurement of diffusivity: Calorimetric studies of Fe/Ni multilayer thin films" *Scripta Mater.* **104**, 1-4 (2015).

DOI:<http://dx.doi.org/10.1016/j.scriptamat.2015.02.031>

134. X. Liu, N. T. Nuhfer, A. P. Warren, M. F. Toney, K. R. Coffey, G. S. Rohrer and K. Barmak, "Grain size dependence of the twin length fraction in nanocrystalline Cu thin films via transmission electron microscopy based orientation mapping", *J. Mater. Res.* **30**, 528-537 (2015).

DOI: 10.1557/jmr.2014.393

133. J. Liu, K. Barmak "Interdiffusion in nanometric Fe/Ni multilayer films", *J. Vac. Sci. Technol. A* **33**, 021510:1-4 (2015).

DOI: 10.1116/1.4905465

132. L. H. Lewis, F. E. Pinkerton, N. Bordeaux, A. Mubarak, E. Poirier, J. Goldstein, R. Skomski, and K. Barmak, "De Magnete et Meteorite: Cosmically motivated materials", *IEEE Magn. Lett.* **5**, 5500104 (2014).

DOI: 10.1109/LMAG.2014.2312178

131. K. Barmak, A. Darbal, K. J. Ganesh and P. J. Ferreira, T. Sun, B. Yao, A. P. Warren, K. R. Coffey, J. M. Rickman, "Surface and grain boundary scattering in nanometric Cu thin films: A quantitative analysis including twin boundaries", *J. Vac. Sci. Technol.* **A32**, 061503:1-8 (2014).

DOI: 10.1116/1.4894453

130. X. Liu, A. P. Warren, N. T. Nuhfer, A. D. Rollett, K. R. Coffey and K. Barmak, "Comparison of crystal orientation mapping-based and image-based measurement of grain size and grain size distribution in a thin aluminum film", *Acta Mater.* **79**, 138-145 (2014).

DOI: <http://dx.doi.org/10.1016/j.actamat.2014.07.014>

129. D. Choi, X. Liu, P. K. Schelling, K. R. Coffey and K. Barmak, "Failure of semiclassical models to describe resistivity of nanometric, polycrystalline tungsten films", *J. Appl. Phys.* **115**, 104308:1-7 (2014).

DOI: 10.1063/1.4868093

128. X. Liu, N. T. Nuhfer, J. S. Carpenter, A. Darbal, J. E. Ledonne, S. B. Lee, A. D. Rollett, K. Barmak, "Interfacial orientation and misorientation relationships in nanolamellar Cu/Nb composites using transmission electron microscope based orientation and phase mapping", *Acta Mater.* **64**, 333-344 (2014).

DOI: <http://dx.doi.org/10.1016/j.actamat.2013.10.046>

127. R. Backofen, K. Barmak, K. R. Elder, A. Voigt, “Grain growth beyond Mullins, capturing the complex physics behind the universal grain size distributions in thin metallic films”, *Acta Mater.* **64**, 72-77 (2014).

DOI: <http://dx.doi.org/10.1016/j.actamat.2013.11.034>

126. K. Barmak, B. Wang, A. T. Jesanis, D. C. Berry, J. M. Rickman, “Quantitative kinetic models of the A1 to L1<sub>0</sub> transformation in FePt and related ternary alloy films”, *IEEE Trans. Magn.* **50**, 2001104:1-4 (2014).

DOI: [10.1109/TMAG.2013.2279132](http://dx.doi.org/10.1109/TMAG.2013.2279132)

125. L. H. Lewis, A. Mubarak, E. Poirier, N. Bordeaux, P. Manchanda, A. Kashyap, R. Skomski, J. Goldstein, F. E. Pinkerton, R. K. Mishra, R. C. Kubic Jr, and K. Barmak, “Inspired by nature: investigating tetrataenite for permanent magnet applications”, *J. Phys.: Condens. Matter* **26**, 064213 (2014).

DOI: [10.1088/0953-8984/26/6/064213](http://dx.doi.org/10.1088/0953-8984/26/6/064213)

124. J. M. Rickman, K. Barmak, “Simulation of metallic conduction in polycrystalline metallic films”, *J. Appl. Phys.* **114**, 133703:1-6 (2013).

DOI: <http://dx.doi.org/10.1063/1.4823985>

123. D. Choi, M. Moneck, X. Liu, S.-J. Oh, C. R. Kagan, K. R. Coffey and K. Barmak, “Crystallographic anisotropy of the resistivity size effect in single crystal tungsten nanowires”, *Nature Scientific Reports* **3**, 2591:1-4 (2013).

DOI: [10.1038/srep02591](http://dx.doi.org/10.1038/srep02591)

122. S. Donegan, J. C. Tucker, A. D. Rollett, and K. Barmak, “Extreme value analysis of tail departure from log-normality in experimental and simulated grain size distributions”, *Acta Mater.* **61**, 5595–5604 (2013).

DOI: <http://dx.doi.org/10.1016/j.actamat.2013.06.001>

121. X. Liu, D. Choi, H. Beladi, N. T. Nuhfer, G. S. Rohrer, K. Barmak, “The five parameter grain boundary character distribution of nanocrystalline tungsten”, *Scripta Mater.* **69**, 413-416 (2013).

DOI: <http://dx.doi.org/10.1016/j.scriptamat.2013.05.046>

120. (*Review Article*) K. Barmak, E. Eggeling, D. Kinderlehrer, R. Sharp, S. Ta’asan, A. D. Rollett, K. R. Coffey “Grain Growth and the Puzzle of its Stagnation in Thin Films: The Curious Tale of a Tail and an Ear”, *Progress in Materials Science* **58**, 987-1055 (2013).

DOI: <http://dx.doi.org/10.1016/j.pmatsci.2013.03.004>

119. L. Li, X. Liu, Y. Zhang, N. T. Nuhfer, K. Barmak, P. A. Salvador, G. S. Rohrer, “Visible light photochemical activity of heterostructured core-shell materials composed of selected ternary titanates and ferrites coated by TiO<sub>2</sub>”, *ACS Applied Materials and Interfaces*, 5064-5071 (2013).

DOI: [dx.doi.org/10.1021/am4008837](http://dx.doi.org/10.1021/am4008837)

118. (*Invited*) P. Manchanda, P. K. Sahota, A. Kashyap, M. J. Lucis, J. E. Shield, A. Mubarak, J. I. Goldstein, S. Constantinides, K. Barmak, L. H. Lewis, D. J. Sellmyer, and R. Skomski, “Intrinsic Properties of Fe-Substituted L<sub>1</sub><sub>0</sub> Magnets”, IEEE Trans. Mag. **49**, 5194-5198 (2013).

117. (*Invited*) K. Barmak, B. Wang, A. T. Jesanis, D. C. Berry and J. M. Rickman, “L<sub>1</sub><sub>0</sub> FePt: Ordering, anisotropy constant and their relation to film composition”, IEEE Trans. Mag. **49**, 3284-3291 (2013).

DOI:10.1109/TMAG.2013.2242445

116. S. D. Granz, K. Barmak and M. H. Kryder, “Granular FePt:X( X = Ag, B, C, SiO<sub>x</sub>, TiO<sub>x</sub>) thin films for heat assisted magnetic recording”, Eur. Phys. J. B **86:81**:1-7(2013).

DOI: 10.1140/epjb/e2012-30655-3

115. A. D. Darbal, K. J. Ganesh, X. Liu, S.-B. Lee, J. Ledonne, T. Sun, B. Yao, A. P. Warren, G. S. Rohrer, A. D. Rollett, P. J. Ferreira, K. R. Coffey, and K. Barmak, “Grain boundary character distribution of nanocrystalline Cu thin films using stereological analysis of transmission electron microscope orientation maps”, Micros. Microanal. **19**, 111-119 (2013).

DOI:10.1017/S1431927612014055

114. D. Choi, C.-S. Kim, S. Chung, A. P. Warren, N. T. Nuhfer, M. F. Toney, K. R. Coffey K. Barmak, “The electron mean free path of tungsten and the resistivity of epitaxial (110) tungsten films”, Phys. Rev. B **86**, 04532:1-5 (2012).

DOI: 10.1103/PhysRevB.86.045432

113. J. S. Carpenter, X. Liu, A. Darbal, N.T. Nuhfer, R. J. McCabe, S. C. Vogel, J. E LeDonne, A. D. Rollett, K. Barmak, I. J. Beyerlein, N.A. Mara, “A comparison of texture results obtained using precession electron diffraction and neutron diffraction methods at diminishing length scales in ordered bi-metallic nanolamellar composites”, Scripta Mater. **67**, 336-339 (2012).

DOI: <http://dx.doi.org/10.1016/j.scriptamat.2012.05.018>

112. J. M. Rickman, K. Barmak, “Resistivity in rough metallic thin films: A Monte Carlo study”, J. Appl. Phys. **112**, 013704 (2012).

DOI: 10.1063/1.4732082

111. K. J. Ganesh, A. Darbal, S. Rajasekhara, G. S. Rohrer, K. Barmak and P. J. Ferreira, “Effect of downscaling copper interconnects on the microstructure revealed by high resolution TEM-orientation-mapping”, Nanotechnology **23**, 134702:1-7 (2012).

DOI: 10.1088/0957-4484/23/13/135702

110. B. Wang, K. Barmak, “The impact of deposition temperature on L<sub>1</sub><sub>0</sub> formation in FePt films”, J. Appl. Phys. **111**, 07B718:1-3 (2012).

DOI: 10.1063/1.3679388

109. S Granz, K. Barmak, M. Kryder, “Granular L<sub>1</sub><sub>0</sub> FePt-B and FePt-Ag (001) thin films for heat assisted magnetic recording”, J. Appl. Phys. **111**, 07B709-1:3 (2012).

DOI: 10.1063/1.3677766

108. A. P. Warren, T. Sun, B. Yao, K. Barmak, M. F. Toney, and K. R. Coffey, "Evolution of nanoscale roughness in Cu/SiO<sub>2</sub> and Cu/Ta interfaces", *Appl. Phys. Lett.* **100**, 024106 (2012).

DOI: 10.1063/1.3675611

107. D. Choi, K. Barmak, A. Darbal, X. Liu, A. Warren, K. R. Coffey, "Phase, grain structure, stress, and resistivity of sputter-deposited tungsten films", *J. Vac. Sci. Technol. A* **29**, 051512:1-8 (2011).

DOI: 10.1116/1.3622619

106. B. Wang, D. C. Berry, Y. Chiari, and K. Barmak, "Experimental measurements of heats of formation of Fe<sub>3</sub>Pt, FePt and FePt<sub>3</sub> using differential scanning calorimetry", *J. Appl. Phys.* **110**, 013903:1-8 (2011).

DOI: 10.1063/1.3601743

105. S. Dillon, L. Helmick, H. M. Miller, C. Johnson, L. Wilson, R. Gemman, R. Petrova, K. Barmak, K. Gerdes, G. S. Rohrer, P. A. Salvador, "The orientation distributions of lines, surfaces, and interfaces around three-phase boundaries in solid oxide fuel cell cathodes", *J. American Ceramic Soc.* **94**, 1-7 (2011).

DOI: 10.1111/j.1551-2916.2011.04673.x

104. B. Wang, K. Barmak, "Re-evaluation of the impact of ternary additions of Ni and Cu on the A1 to L1<sub>0</sub> transformation in FePt films", *J. Appl. Phys.* **109**, 123916:1-7 (2011).

DOI: 10.1063/1.3592980

103. (*Editor Selection*) K. Barmak, E. Eggeling, M. Emelianenko, Y. Ephshteyn, D. Kinderlehrer, R. Sharp, S. Ta'asan, "Critical events, entropy and the grain boundary character distribution", *Phys. Rev. B* **83**, 134117:1-12 (2011).

DOI: 10.1103/PhysRevB.83.134117

102. K. Barmak, E. Eggeling, M. Emelianenko, Y. Ephshteyn, D. Kinderlehrer, R. Sharp, S. Ta'asan, "An entropy based theory of the grain boundary character distribution", *Discrete and Continuous Dynamical Systems A* **30**, 427 (2011).

DOI: 10.3934/dcds.2011.30.427

101. B. Wang, K. Barmak, and T. J. Klemmer, "The A1 to L1<sub>0</sub> transformation in FePt films with ternary alloying additions of Mg, V, Mn and B", *J. Appl. Phys.* **109**, 07B739-1:3 (2011).

DOI: 10.1063/1.3559482

100. K. Barmak, "A commentary on: "Reaction kinetics in the processes of nucleation and growth," by W. A. Johnson, R. F. Mehl, *Trans. AIME* **35**, 416-58 (1939)", reprinted with the original unpublished appendices now included, *Met. Trans. A* **41**, 2711-2712 (2010).

DOI: 10.1007/s11661-010-0421-1

A series of classic articles in metallurgy is being reprinted in Metallurgical Transactions. Each article is preceded by a commentary by an invited scholar who is considered highly knowledgeable in the field.

99. B. Wang, K. Barmak, T. J. Klemmer, “The A1 to L1<sub>0</sub> transformation in FePt films with ternary alloying additions of Ag and Au”, IEEE Trans. Magn. **46**, 1773-1776 (2010).  
DOI: 10.1109/TMAG.2010.2042039
98. T. Sun, Bo Yao, A. P. Warren, K. Barmak, M. F. Toney, R. E. Peale, and K. R. Coffey, “Surface and grain-boundary scattering in nanometric Cu films”, Phys. Rev. B **81**, 155454:1-12 (2010).  
DOI: 10.1103/PhysRevB.81.155454
97. B. Yao, T. Sun, A. Warren, H. Heinrich, K. Barmak, K. R. Coffey, “High contrast hollow-cone dark field transmission electron microscopy for nanocrystalline grain size determination”, Micron **41**, 177-182 (2010).  
DOI: 10.1016/j.micron.2009.11.008
96. V. I. Dybkov, V. G. Khoruzha, V.R. Sidorko, K. A. Meleshevich, A. V. Samelyuk, D. C. Berry, K. Barmak, "Interfacial interaction of solid cobalt with liquid Pb-free Sn-Bi-In-Zn-Sb soldering alloys", J. Mater. Sci. **44**, 5960-5979 (2009).  
DOI: 10.1007/s10853-009-3717-z
95. T. Sun, B. Yao, A. P. Warren, K. Barmak, M. F. Toney, R. E. Peale, and K. R. Coffey, “Dominant role of grain boundary scattering in the resistivity of nanometric Cu films”, Physical Review B **79**, 041402(R):1-3 (2009).  
DOI: 10.1103/PhysRevB.79.041402
94. A. Warren, R. M. Todi, B. Yao, K. Barmak, R. Sundaram, “On the phase identification of dc magnetron sputtered Pt-Ru alloy thin films”, J. Vac. Sci. Technol. A **26**, 1208-1212 (2008).  
DOI: 10.1116/1.2966422
93. V. I. Dybkov, V. G. Khoruzha, V. R. Sidorko, K. A. Meleshevich, A.V. Samelyuk, D. C. Berry, and K. Barmak, “Interfacial interaction of solid nickel with liquid Pb-free Sn-Bi-In-Zn-Sb soldering alloys”, J. Alloys and Compounds **460**, 337-352 (2008).  
DOI: 10.1016/j.jallcom.2007.06.056
92. T. Sun, B. Yao, A. Warren, V. Kumar, S. Roberts, K. Barmak, and K. R. Coffey, “Classical size effect in oxide-encapsulated Cu thin films: Impact of grain boundaries versus surfaces on resistivity”, J. Vac. Sci. Technol. A **26**, 605-609 (2008).  
DOI: 10.1116/1.2938395
91. T. Sun, B. Yao, V. Kumar, K. Barmak, K. R. Coffey, “Grain growth in dielectric-encapsulated Cu thin films”, J. Materials Research **23**, 2033-2039 (2008).  
DOI: 10.1557/jmr.2008.0254

90. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, and S. Ta'asan, "Towards a statistical theory of texture evolution in polycrystals", SIAM J. Sci. Comput. **30**, 3150-3169 (2008).

DOI:10.1137/070692352

89. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, and S. Ta'asan, "A new perspective on texture evolution", Intl. J. Numer. Anal. Modeling **5**, Supplement (Special Issue on Modeling, Analysis and Simulations of Multiscale Nonlinear Systems), 93-108 (2008).

88. D. C. Berry and K. Barmak, "Effect of alloy composition on the thermodynamic and kinetic parameters of the A1 to L1<sub>0</sub> transformation in FePt, FeNiPt and FeCuPt films", J. Appl. Phys. **102**, 024912-1:9 (2007).

DOI: 10.1063/1.2756631

87. R. M. Todi, M. S. Erickson, K. B. Sundaram, K. Barmak, K. R. Coffey, "Comparison of the work function of Pt-Ru binary metal alloys extracted from MOS capacitor and Schottky barrier diode measurements", IEEE Trans. Electron Devices **54**, 807-813 (2007).

DOI: 10.1109/TED.2007.892352

86. D. C. Berry, K. Barmak, "Time-temperature-transformation diagrams for the A1 to L1<sub>0</sub> phase transformation in FePt and FeCuPt thin films", J. Appl. Phys. **101**, 014905-1:14 (2007).

DOI: 10.1063/1.2403835

85. (*Critical Review*) K. Barmak, C. Cabral, Jr., J. M. E. Harper, K. P. Rodbell, "On the use of alloying elements for Cu interconnect applications", J. Vac. Sci. Technol. B **24**, 2485-2498 (2006).

DOI: 10.1116/1.2357744

84. R. M. Todi, A. P. Warren, K. B. Sundaram, K. Barmak, K. R. Coffey, "Characterization of Pt-Ru binary alloy thin films for work function tuning", IEEE Electron Device Lett. **27**, 542-545 (2006).

DOI: 10.1109/LED.2006.876326

83. D. C. Berry, K. Barmak, "The A1 to L1<sub>0</sub> transformation in FePt and FeCuPt thin films: determination of isothermal transformation kinetics from non-isothermal measurements", J. Appl. Phys. **99**, 08G901-1:3 (2006).

DOI: 10.1063/1.2151820

82. (*Invited*) K. Barmak, J. Kim, C.-S. Kim, W. E. Archibald, G. R. Rohrer, A. D. Rollett, D. Kinderlehrer, S. Ta'asan, H. Zhang, D. J. Srolovitz, "Grain boundary energy and grain growth in Al films: Comparison of experiments and simulations", Scripta Mater. **54**, 1059-1063 (2006).

DOI: 10.1016/j.scriptamat.2005.11.060

81. K. Barmak, C. Cabral, Jr., J. M. E. Harper, "Resistivity-Temperature Behavior of Dilute Cu(Ir) and Cu(W) Alloy Films", J. Mater. Res. **20**, 3391-3396 (2005).

DOI: 10.1557/jmr.2005.0416

80. P. F. Fewster, N. L. Andrew, V. Holý, K. Barmak, “X-ray diffraction from polycrystalline multilayers in grazing-incidence geometry: Measurement of crystallite size depth distribution”, *Phys. Rev. B* **72**, 174105-1:11 (2005).  
DOI: 10.1103/PhysRevB.72.174105
79. V. I. Dybkov, W. Lenagauer, K. Barmak, “Formation of boride layers at the Fe–10%Cr alloy-boron interface”, *J. Alloys and Compounds* **398**, 113-122 (2005).  
DOI: 10.1016/j.jallcom.2005.02.033
78. K. Barmak, J. Kim, L. H. Lewis, K. R. Coffey, M. F. Toney, A. J. Kellock and J.-U. Thiele, “On the relationship of magnetocrystalline anisotropy and stoichiometry in epitaxial L1<sub>0</sub> CoPt (001) and FePt (001) thin films”, *J. Appl. Phys.* **98**, 033904-1:10 (2005).  
DOI: 10.1063/1.1991968
77. D. C. Berry, J. Kim, K. Barmak, K. Wierman, E. B. Svedberg, and J. K. Howard, “Differential scanning calorimetry studies of the effect of Cu on the A1 to L1<sub>0</sub> transformation in FePt thin films”, *Scripta Mater.* **53**, 423-428 (2005).  
DOI:10.1016/j.scriptamat.2005.04.026
76. D. C. Crew, R. L. Stamps, H. Y. Liu, Z. K. Wang, M. H. Kuok, S. C. Ng, K. Barmak, J. Kim, L. H. Lewis, “Light scattering from spin wave excitations in a Co/CoPt exchange spring”, *J. Magn. Mater.* **209-210**, 530-532 (2005).  
DOI: 10.1016/j.jmmm.2004.11.519
75. V. I. Dybkov, K. Barmak, W. Lenagauer, P. Gas, “Interfacial reaction of solid nickel with liquid bismuth and Bi-based alloys”, *J. Alloys Compounds* **389**, 61-74 (2005).  
DOI: 10.1016/j.jallcom.2004.02.063
74. K. Barmak, J. Kim, D. C. Berry, W. N. Hanani, K. Wierman, E. B. Svedberg, and J. K. Howard, “Calorimetric studies of the A1 to L1<sub>0</sub> transformation in binary FePt thin films with compositions in the range of 47.5 to 54.4 at% Fe” *J. Appl. Phys.* **97**, 024902-1:7 (2005).  
DOI: 10.1016/j.jallcom.2004.02.063
73. J. M. Rickman, K. Barmak, “Microstructural characterization associated with solid-solid transformations”, *Handbook of Materials Modeling*, Springer, Netherlands, 2391-2402 (2005).
72. Y. Ding, S. A. Majetich, J. Kim, K. Barmak, H. Rollins, P. Sides, “Sintering prevention and phase transformation of FePt nanoparticles”, *J. Magn. Mater.* **284**, 336-341 (2004).  
DOI: 10.1016/j.jmmm.2004.07.011
71. L. H. Lewis, J. Kim, K. Barmak, and D. C. Crew, “Interphase exchange effects in CoPt/Co bilayer thin films”, *J. Phys. D: Appl. Phys.* **37**, 2638-2642 (2004).  
DOI: 10.1088/0022-3727/37/19/004
70. K. Barmak and V. I. Dybkov, “Interaction of iron-chromium alloys containing 10 and 25



mass% chromium with liquid aluminium: Part II – Formation of intermetallic compounds”, *J. Mater. Sci.* **39**, 4219-4230 (2004).

DOI: 10.1023/B:JMSC.0000033402.37206.27

69. K. Barmak, J. Kim, D. C. Berry, K. W. Wierman, E. B. Svedberg and J. K. Howard, “Calorimetric Studies of the A1 to L1<sub>0</sub> Transformation in FePt and Related Ternary Alloy Thin Films”, *J. Appl. Phys.* **95**, 7486-7488 (2004).

DOI: 10.1063/1.1682786

68. K. Barmak, J. Kim, L. H. Lewis, K. R. Coffey, M. F. Toney, A. J. Kellock and J.-U. Thiele “Stoichiometry – Anisotropy Connections in Epitaxial L1<sub>0</sub> FePt(001) Films”, *J. Appl. Phys.* **95**, 7501-7503 (2004).

DOI: 10.1063/1.1667856

67. D. C. Crew, R. L. Stamps, H. Y. Liu, Z. K. Wang, M. H. Kuok, S. C. Ng, K. Barmak, J. Kim, L. H. Lewis, “Spin wave excitations in exchange spring Co/CoPt thin film bilayers”, *J. Magn. Mater.* **272-276**, 273-274 (2004).

DOI: 10.1016/j.jmmm.2004.04.061

66. Q. Zhao, D. W. Greve, K. Barmak, “UHV/CVD growth of Co on Si(001) using cobalt carbonyl”, *Appl. Surf. Sci.* **219**, 136-142 (2003).

DOI: 10.1016/S0169-4332(03)00597-X

65. S.-B. Lee, J. M. Rickman, and K. Barmak, “Phase transformation kinetics and self-patterning in misfitting thin films”, *Acta Mater.* **51**, 6415-6427 (2003).

DOI: 10.1016/j.actamat.2003.08.021

64. C. Park, Y. Shi, Y. Peng, K. Barmak, D. E. Laughlin, J. Zhu and R. W. White, “Interfacial composition and microstructure of Fe<sub>3</sub>O<sub>4</sub> magnetic tunnel junctions”, *IEEE Trans. Mag.* **39**, 2806-2808 (2003).

DOI: 10.1109/TMAG.2003.815718

63. K. Barmak, A. Gungor, C. Cabral, Jr., and J. M. E. Harper, “Annealing behavior of Cu and dilute Cu-alloy thin films: Precipitation, grain growth and resistivity”, *J. Appl. Phys.* **94**, 1605-1616 (2003).

DOI: 10.1063/1.1589593

62. K. Barmak, A. Gungor, A. D. Rollett, C. Cabral, Jr., and J. M. E. Harper, “Texture of Cu and dilute binary Cu-alloy films: Impact of annealing and solute content”, *Mater. Sci. in Semicon. Processing* **6**, 175-184 (2003).

DOI: 10.1016/S1369-8001(03)00062-3

61. K. Barmak, and V. Dybkov, “Interaction of iron-chromium alloys containing 10 and 25 mass% chromium with liquid aluminium, Part I, Dissolution Kinetics”, *J. Mater. Sci.* **38** 3249-3255 (2003).

DOI: 10.1023/A:1025129803413

60. D. C. Crew, J. Kim, K. Barmak and L. H. Lewis, "Robust exchange coupling in bilayer exchange spring thin films", *J. Appl. Phys.* **93**, 7235-7237 (2003).  
DOI: 10.1063/1.1557313
59. L. H. Lewis, J. Kim, K. Barmak, and R. A. Ristau, "The CoPt system: A natural exchange spring", International Symposium on Advanced Magnetic Materials (ISAMM '02), Oct. 2-4, 2002, Halong Bay, Vietnam, *Physica B* **327**, 190-193 (2003).  
DOI: 10.1016/S0921-4526(02)01725-8
58. J. Kim, K. Barmak, and L. H. Lewis, "L1<sub>0</sub>-CoPt/Co bilayer ferromagnetic films: interdiffusion, structure and microstructure", *Acta Mater.* **51**, 313-323 (2003).
57. A Gungor, K. Barmak, A. D. Rollett, C. Cabral, Jr., and J. M. E. Harper, "Texture and resistivity of dilute binary Cu(Al), Cu(In), Cu(Ti), Cu(Nb), Cu(Ir) and Cu(W) alloy thin films", *J. Vac. Sci. Technol. B* **20**, 2314-2319 (2002).  
DOI: 10.1116/1.1520549
56. K. Barmak, J. Kim, R. A. Ristau, and L. H. Lewis, "Ferromagnetic exchange-spring nanocomposites of Al + L1<sub>0</sub> CoPt", *IEEE Trans. Magn.* **38**, 2799-2801 (2002).  
DOI: 10.1109/TMAG.2002.803107
55. K. Barmak, J. Kim, S. Shell, E. B. Svedberg, and J. K. Howard, "Calorimetric studies of the Al to L1<sub>0</sub> transformation in FePt and CoPt thin films", *Appl. Phys. Lett.* **80**, 4268-4270 (2002).  
DOI: 10.1063/1.1477257
54. G. Lucadamo, K. Barmak, C. Lavoie, Cyril Cabral, Jr., and C. Michaelson, "Metastable and equilibrium phase formation in sputter-deposited Ti/Al multilayer thin films", *J. Appl. Phys.* **91**, 9575-9583 (2002).  
DOI: 10.1063/1.1483924
53. D. C. Crew, J. Kim, L. H. Lewis, and K. Barmak, "Interdiffusion in bilayer CoPt/Co films: Potential for tailoring the magnetic exchange spring", *J. Magn. and Magn. Mater.* **233**, 257-273 (2001).  
DOI:10.1016/S0304-8853(01)00277-3
52. D. C. Crew, L. H. Lewis, J. Kim, K. Barmak, "Magnetic signature of compositional gradient in exchange-spring behavior of films of CoPt/Co", *J. Appl. Phys.* **89**, 7528-7530 (2001).  
DOI: 10.1063/1.1354594
51. G. Lucadamo, K. Barmak, D. T. Carpenter and J. M. Rickman, "Microstructure evolution during solid state reactions of Nb/Al multilayers", *Acta Mater.* **49**, 2813-2826 (2001).  
DOI: 10.1016/S1359-6454(01)00176-8
50. G. Lucadamo, K. Barmak, "Stress evolution in polycrystalline thin film reactions", *Thin Solid Films* **389**, 8-11 (2001).

DOI: 10.1016/S0040-6090(01)00861-6

49. G. Lucadamo, K. Barmak and K. P. Rodbell, "Texture in Nb/Al and Ti/Al multilayer thin films: Role of Cu", *J. Mater. Res.* **16**, 1449-1459 (2001).

DOI: 10.1557/JMR.2001.0202

48. W. S. Tong, J. M. Rickman, and K. Barmak, "Impact of local interactions on the evolution of a phase transformation", *J. Chem. Phys.* **114**, 915-922 (2001).

DOI: 10.1063/1.1331568

47. K. Barmak, G. A. Lucadamo, C. Cabral, Jr., C. Lavoie, and J.M. E. Harper, "Dissociation of dilute immiscible copper alloy thin films", *J. Appl. Phys.* **87**, 2204-2214 (2000).

DOI: 10.1063/1.372162

46. J. Kim, K. Barmak, M. DeGraef, L. H. Lewis, and D. C. Crew, "The effect of annealing on magnetic exchange-coupling in CoPt/Co bilayer thin films", *J. Appl. Phys.* **87**, 6140-6142(2000).

DOI: 10.1063/1.372635

45. W. S. Tong, J. M. Rickman, and K. Barmak, "Evolution of perimeter fraction during a phase transformation", *Acta Mater.* **48**, 1181-1186 (2000).

DOI: 10.1016/S1359-6454(99)00376-6

44. G. A. Lucadamo, K. Barmak, and S. Hyun, "Nb/Al and Nb/Al(Cu) multilayer thin films: the enthalpy of formation of NbAl<sub>3</sub>", *Thermochimica Acta* **348**, 53-59 (2000).

DOI: 10.1016/S0040-6031(99)00512-2

43. (*Invited*) K. Barmak, J. M. Rickman, "Microstructural implications of nucleation and growth in thin film transformations: Theory, simulation and experimental perspectives", *Metals. Mater. and Processes* **11**, 177-190 (1999).

42. D. T. Carpenter, M. Watanabe, K. Barmak, and D. B. Williams, "Low-magnification quantitative x-ray mapping of grain boundary segregation in aluminum – 4 wt.% copper by analytical electron microscopy", *Micros. Microanal.* **5**, 254-266 (1999).

41. D. T. Carpenter, J. R. Codner, K. Barmak, and J. M. Rickman, "Issues associated with the analysis and acquisition of thin film grain size data", *Mater. Lett.* **41**, 296-302 (1999).

DOI: 10.1016/S0167-577X(99)00146-9

40. R. A. Ristau, K. Barmak, K. R. Coffey, and J. K. Howard, " Grain growth in ultra-thin films of CoPt and FePt", *J. Mater. Res.* **14**, 3263-3270 (1999).

DOI: 10.1557/JMR.1999.0441

39. R. A. Ristau, K. Barmak, L. Henderson-Lewis, K. R. Coffey, J. K. Howard, " On the relationship of ordering and coercivity in thin films of CoPt and FePt", *J. Appl. Phys.* **86**, 4527-4533 (1999).

DOI: 10.1063/1.371397

38. (*Invited*) K. Barmak, J. M. Rickman, C. Michaelsen, R. A. Ristau, J. Kim, G. A. Lucadamo, D. T. Carpenter, and W. S. Tong, “Ex situ characterization of phase transformations and associated microstructures in polycrystalline thin films”, *J. Vac. Sci. Technol.* **A17**, 1950-1957 (1999).

DOI: 10.1116/1.581709

37. S. W. Banovic, K. Barmak, and A. R. Marder, “Characterization of single and discretely-stepped electro-composite coatings of nickel-alumina”, *J. Mater. Sci.* **34**, 3203-3211 (1999).

DOI: 10.1023/A:1004633923681

36. G. Lucadamo, K. Barmak, C. Lavoie, C. Cabral, Jr., and J. M. E. Harper, “Evidence of a two-stage reaction mechanism in sputter deposited Nb/Al multilayer thin films studied by in situ synchrotron x-ray diffraction”, *Mater. Lett.* **39**, 268-273 (1999).

DOI: 10.1016/S0167-577X(99)00017-8

35. G. Lucadamo, M. Watanabe, K. Barmak, D. B. Williams, C. Michaelsen, and R. Alani, “High resolution quantitative x-ray microanalysis of Nb/Al multilayer thin films using the  $\zeta$ -factor analysis”, *Philos. Mag.* **79**, 1423-1442 (1999).

DOI: 10.1080/01418619908210370

34. W. S. Tong, J. M. Rickman, and K. Barmak, “Quantitative analysis of spatial distribution of nucleation sites: microstructural implications”, *Acta Mater.* **47**, 435-445 (1999).

33. D. T. Carpenter, J. M. Rickman, and K. Barmak, “A methodology for automated quantitative microstructural analysis of transmission electron micrographs”, *J. Appl. Phys.* **84**, 5843-5854 (1998).

32. D. B. Williams, M. Watanabe, D. T. Carpenter, G. Lucadamo and K. Barmak, “Thin film analysis and chemical mapping in the analytical electron microscope”, *Mikrochim. Acta*, [Suppl] **15**, 49-57 (1998) and erratum (1999).

31. R. A. Ristau, F. Hofer, K. Barmak, K. R. Coffey, J. K. Howard, “An EFTEM and conical dark field investigation of co-sputtered CoPt + yttria stabilized zirconia thin films”, *Micron* **29**, 33-41 (1998).

DOI: 10.1016/S0968-4328(97)00065-6

30. K. Barmak, C. Michaelsen, S. Vivekanand, and F. Ma, “Formation of the first phase in sputter-deposited Nb/Al multilayer thin films”, *Philos. Mag.* **77**, 167- (1998).

29. S. W. Banovic, K. Barmak and A. R. Marder, “Microstructural characterization and hardness of electrodeposited nickel coatings from a sulfamate bath”, *J. Mater. Science* **33**, 639-645 (1998).

DOI: 10.1023/A:1004321224586

28. D. F. Susan, K. Barmak and A. R. Marder, “Electrodeposited Ni-Al particle composite

coatings”, *Thin Solid Films* **307**, 133-140 (1997).

DOI: 10.1016/S0040-6090(98)80004-7

27. (*Invited Review*) C. Michaelsen, K. Barmak and T. P. Weihs, “Investigating the thermodynamics and kinetics of thin film reactions by differential scanning calorimetry”, *J. Phys. D*, **30**, 3167-3186 (1997).

DOI: 10.1088/0022-3727/30/23/001

26. (*Invited*) K. Barmak, J. Rickman, and C. Michaelsen, “Evolution of grain structure in thin film reactions”, *J. Electronic Materials* **26**, 1009-1019 (1997).

DOI: 10.1007/s11664-997-0238-x

25. C. Michaelsen, K. Barmak, “Calorimetric determination of NiAl<sub>3</sub>-growth kinetics in sputter-deposited Ni/Al diffusion couples”, *J. Alloys and Compounds* **257**, 211-214 (1997).

DOI: 10.1016/S0925-8388(97)00014-5

24. K. Barmak, L. Friedersdorf, “Processing of layered metal matrix composite and ceramic coatings by electrochemical methods”, *Materials Technology* **12**, 52-54 (1997).

23. W. S. Tong, J. M. Rickman and K. Barmak, “Impact of heterogeneous boundary nucleation on product grain size distribution”, *J. Mater. Res.* **12**, 1501-1507 (1997).

DOI: 10.1557/JMR.1997.0206

22. K. Barmak, C. Michaelsen and F. Ma, “Study of solid state reactions in Nb/Al multilayer thin films by differential scanning calorimetry”, *J. Thermal Analysis* **49**, 1179-1185 (1997).

DOI: 10.1007/BF01983673

21. K. Barmak, S. W. Banovic, C. M. Petronis, D. F. Susan and A. R. Marder, “Structure of electrodeposited graded composite coatings of Ni-Al-Al<sub>2</sub>O<sub>3</sub>”, *J. Microscopy*, **185**, 265-274 (1997).

DOI: 10.1557/JMR.1997.0021

20. J. M. Rickman, W. S. Tong and K. Barmak, “Impact of heterogeneous boundary nucleation on transformation kinetics and microstructure”, *Acta Mater.* **45**, 1153-1166 (1997).

DOI: 10.1016/S1359-6454(96)00245-5

19. K. Barmak, C. Michaelsen, G. Lucadamo, “Reactive phase formation in sputter deposited Ni/Al multilayer thin films”, *J. Mater. Res.* **12**, 133-146 (1997).

18. C. Michaelsen, G. Lucadamo and K. Barmak, “The early stages of solid-state reactions in Ni/Al multilayer thin films”, *J. Appl. Phys.* **80**, 6689-6697 (1996).

DOI: 10.1063/1.363794

17. K. Barmak, R. A. Ristau, K. R. Coffey, M. A. Parker, and J. K. Howard, “Grain growth and ordering kinetics in Co-Pt thin films”, *J. Appl. Phys.* **79**, 5330-5332 (1996).

DOI: 10.1063/1.361368

16. E. T. Yu, K. Barmak, P. Ronsheim, M. B. Johnson, P. McFarland, J.-M. Halbout, "Two-dimensional profiling of shallow junctions in Si metal-oxide-semiconductor structures using tunneling spectroscopy and transmission electron microscopy, *J. Appl. Phys.* **79**, 2115-2121 (1996).

DOI: 10.1063/1.361069

15. K. R. Coffey, K. Barmak "A new model for grain boundary diffusion and nucleation in thin film reactions", *Acta Metall. et Mater.* **42**, 2905-2911 (1994).

DOI: 10.1016/0956-7151(94)90232-1

14. J. G. Pellerin, S. G. H. Anderson, P. S. Ho, C. Wooten, K. R. Coffey, J. K. Howard, K. Barmak, "Grain boundary diffusion and its effects on the magnetic properties of Co/Cu and Co/Cr thin film bilayers", *J. Appl. Phys.* **75**, 5052-5060 (1994).

DOI: 10.1063/1.355747

13. Q. Z. Hong, K. Barmak, S. Q. Hong, L. A. Clevenger, "Crystallization of coevaporated and ion irradiated amorphous  $\text{CoSi}_2$ ", *J. Appl. Phys.* **74**, 4958-4962 (1993).

DOI: 10.1063/1.354334

12. C. Cabral, Jr., K. Barmak, L. A. Clevenger, J. Gupta, D. A. Smith, J. M. E. Harper "Role of stress relief in the hexagonal-close-packed to face-centered-cubic transformation in cobalt thin films", *J. Vac. Sci. Technol.* **A11**, 1435-1440 (1993).

DOI: 10.1116/1.578569

11. Q. Z. Hong, K. Barmak, F. M. d'Heurle, "Formation of a C49  $\text{TiGe}_2$  phase during annealing a coevaporated  $\text{Ti}_{0.33}\text{Ge}_{0.67}$  alloy", *Appl. Phys. Lett.* **62**, 3435-3437 (1993).

DOI: 10.1063/1.109040

10. L. A. Clevenger, A. Mutscheller, J. M. E. Harper, C. Cabral Jr., K. Barmak, "The relationship between deposition conditions, the beta to alpha phase transformation, and stress relaxation in tantalum thin films", *J. Appl. Phys.* **72**, 4918-4924 (1992).

DOI: 10.1063/1.352059

9. Q. Z. Hong, K. Barmak, L. A. Clevenger, "Crystallization of amorphous Co-Si alloys", *J. Appl. Phys.* **72**, 3423-3430 (1992).

DOI: 10.1063/1.351415

8. K. R. Coffey, K. Barmak, D. A. Rudman, and S. Foner, "Thin film reaction kinetics of niobium/aluminum multilayers", *J. Appl. Phys.* **72**, 1341-1349 (1992).

DOI: 10.1063/1.351744

7. K. Barmak, D. A. Rudman, and S. Foner, "The preparation of cross-sectional transmission electron microscopy specimens of Nb/Al multilayer thin films on sapphire substrates", *J. Electron Microsc. technique*, **16**, 249-253 (1990).

DOI: 10.1002/jemt.1060160306

6. K. Barmak, K. R. Coffey, D. A. Rudman, and S. Foner, "Phase formation sequence for the reaction of multilayer thin films of Nb/Al", *J. Appl. Phys.* **67**, 7313-7322 (1990).  
DOI: 10.1063/1.344517
5. K. Barmak, K. R. Coffey, D. A. Rudman, and S. Foner, "The effect of oxygen on phase formation in Al/Nb diffusion couples", *J. Appl. Phys.* **67**, 3780-3783 (1990).  
DOI: 10.1063/1.345023
4. J. Y. Juang, K. Barmak, D. A. Rudman, and R. B. van Dover, "Enhancement of the critical current by grain size refinement in Ta-cosputtered NbN thin films", *J. Appl. Phys.* **66**, 3136-3143 (1989).  
DOI: 10.1063/1.344149
3. K. R. Coffey, L. A. Clevenger, K. Barmak, D. A. Rudman, and C. V. Thompson, "Experimental evidence for nucleation during thin-film reactions", *Appl. Phys. Lett.* **55**, 852-854 (1989).  
DOI: 10.1063/1.102447
2. K. R. Coffey, K. Barmak, D. A. Rudman, C. L. H. Thieme, and S. Foner, "Reaction kinetics of phase formation in Nb-Al powder metallurgy processed wire", *IEEE Trans. Magn.* **MAG-25**, 20932096 (1989), and presented at the Applied Superconductivity Conference, San Francisco (1988).  
DOI: 10.1109/20.92720
1. K. Barmak, S. N. Basu, A. J. Garratt-Reed, and G. J. Yurek, "Microstructure and grain growth of rapidly solidified Fe-Cr-Ni-Mn-Si alloys", *International J. Rapid Solidification* **4**, 205-218 (1989).

#### **PROCEEDINGS AND CONFERENCE RELATED PUBLICATIONS (Peer Reviewed)**

68. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R. Sharp, S. Ta'asan, "Recent Developments in Material Microstructure: a Theory of Coarsening", *Mater. Res. Soc. Symp. Proc* **1753**, 2015.  
DOI:10.1557/opl.2015.591
67. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R. Sharp, and S. Ta'asan, "Materials microstructure: entropy and curvature driven coarsening", M. Taniguchi, Ed., *Research Institute for Mathematical Sciences, University of Kyoto*, number 1881, 71-91 (2014).
66. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R. Sharp, and S. Ta'asan, "A Theory and Challenges for Coarsening in Microstructure", *Analysis and Numerics of Partial Differential Eqs.*, Conference in Memory of Enrico Magenes, Franco Brezzi, Piero Colli Franzone, Ugo Gianazza, Gianni Gilardi, Eds., Springer INdAM Series, Milan, Italy (2013).

DOI 10.1007/978-88-470-2592-9

65. K. R. Coffey, K. Barmak, Grain boundary and surface scattering in interconnect metals”, IEEE International Interconnect Technology Conference, 2013.

DOI: 10.1109/IITC.2013.6615565

64. X. Liu, J. T. Nuhfer, J. S. Carpenter, A. Darbal, J. E. Ledonne, S. B. Lee, A. D. Rollett, K. Barmak, “Precession-Assisted Nanoscale Phase and Crystal Orientation Mapping of Cu-Nb Composites in the Transmission Electron Microscope”, Microscopy and Microanalysis **18** (Suppl. 2), 1426-1427 (2012).

63. K. Barmak, E. Eggeling, R. Sharp, S. Roberts, T. Shyu, T. Sun, B. Yao, S. Ta’san, D. Kinderlehrer, A. Rollett, K. Coffey, “Grain growth and the puzzle of its stagnation in thin Films: A detailed comparison of experiments and simulations”, Materials Science Forum, Trans. Tech. **715-716**, 473-479 (2012).

DOI:10.4028/www.scientific.net/MSF.715-716.473

62. K. Barmak, E. Eggeling, M. Emelianenko, Y. Ephshteyn, D. Kinderlehrer, R. Sharp, S. Ta’asan, “Predictive theory for the grain boundary character distribution”, Materials Science Forum, Trans. Tech. **715-716**, 279-285 (2012).

DOI:10.4028/www.scientific.net/MSF.715-716.279

61. A. Darbal, K. J. Ganesh, K. Barmak, G. S. Rohrer, P.J. Ferreira, T. Sun, K. R. Coffey, “Grain boundary characterization of nanocrystalline Cu from the stereological analysis of transmission electron microscope orientation maps”, Microscopy and Microanalysis **17** (Suppl. 2), 1426-1427 (2011).

DOI:10.1017/S1431927611008002

60. K. J. Ganesh, A. Darbal, S. Rajasekhara, G. S. Rohrer, K. Barmak, P. J. Ferreira, “Characterizing Texture and Grain Boundaries in Nanoscale Cu Interconnects by Precession Electron Diffraction”, Proceedings of Microscopy and Microanalysis **17** (Suppl. 2), 1346-1347 (2011).

DOI:10.1017/S1431927611007604

59. E. F. Rauch , K. Barmak, J. K. Ganesh, P. Ferreira, A. Darbal, D. Choi, T. Sun, B. Yao, K. R. Coffey, and S. Nicolopoulos, “TEM automated orientation and phase mapping for thin film applications”, Proceedings of Microscopy and Microanalysis **17** (Suppl. 2), 1086-1087 (2011).

DOI:10.1017/S1431927611006301

58. (Invited) K. Barmak, T. Sun, K. R. Coffey, “Impact of surface and grain boundary scattering on the resistivity of nanometric Cu interconnects”, AIP Conf. Proc. **1300**, Eds. E. Zschech, P. S. Ho, S. Ogawa, 12-22 (2010).

DOI: <http://dx.doi.org/10.1063/1.3527118>

57. A. Darbal, K. Barmak, N. T. Nuhfer, T. Sun, K. R. Coffey “Grain size determination and grain boundary characterization of nanocrystalline thin films from conical dark field imaging”,



Proceedings of Microscopy and Microanalysis **15**, Supplement 2, 1232-1233(2010).

56. A. Darbal, K. Barmak, N. T. Nuhfer, D. J. Dingley, G. Meaden, J. Michael, T. Sun, K. R. Coffey, "Orientation Imaging of Nanocrystalline Platinum Films in the TEM", Proceedings of Microscopy and Microanalysis **15**, Supplement 2, 1232-1233(2009).

55. K. Barmak, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, S. Ta'asan, "Geometric growth and character development in large metastable systems", Rendiconti di Matematica, Serie VII, **29**, 65-81(2009).

54. K. Barmak, D. C. Berry, V. G. Khoruzha, V. R. Sidorko, K. A. Meleshevich, A.V. Samelyuk, V. I. Dybkov, "Dissolution kinetics and diffusion of cobalt in Pb-free Sn-Bi-In-Zn-Sb soldering alloys", Proceedings of Materials Science and Technology (MS&T), 262-273 (2008).

53. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, and S. Ta'asan, "On a statistical theory of critical events in microstructural evolution", Proc. of the 11th International Symposium on Continuum Models and Discrete Systems (CMDS11), (ENSMP Press, Paris), 185-194 (2008).

52. S. Zhang, Y. Zhang, Y. Rabin, K. Barmak, M. Asheghi, "A novel experimental procedure and technique for small scale calorimetry", Proc. HT2007, ASME-JSME Thermal Engineering Summer Heat Transfer Conference, HT2007, 32894-1:7 (2007).

51. (*Invited*) D. C. Berry, and K. Barmak, "L<sub>10</sub> Ordered Intermetallics for ultrahigh density magnetic recording media: phase formation and the role of alloy chemistry and composition", Mater. Res. Soc. Symp. Proc., 0980-II03-05:1-12 (2006).

50. K. Barmak, D. Kinderlehrer, I. Livshits, and S. Ta'asan, "Remarks on a multiscale approach to grain growth in polycrystals", Progress in Nonlinear Differential Equations Applications, Vol. 68, edited by Gianni dal maso, Antonio DeSimone, and Franco Tomarelli (Birkhauser, Basel 2006), pp. 1-11.

49. K. Barmak, W. E. Archibald, J. Kim, C.-S. Kim, A. D. Rollett, G. S. Rohrer, S. Ta'asan, D. Kinderlehrer, "Grain boundary energy and grain growth in highly-textured Al films and foils: Experiment and Simulation", ICOTOM 14, Materials Science Forum **495-497**, 1255-1260 (2005).

48. K. Barmak, D. Kinderlehrer, I. Livshits, and S. Ta'asan, "Remarks on a multiscale approach to grain growth in polycrystals", Proc. of Variational Problems in Materials Science, Trieste (2004).

47. M. Asheghi, Y. Yang, S. Sadeghipour, J. A. Bain, K. Barmak, M. S. Jhon, A. Gellman, E. Schlesinger, J. G. Zhu, and R. M. White, "Nanoscale energy transport in information technology research with an application to high-density data storage devices and systems", Proc. of IMECE Conference.

46. S. Zhang, Y. Yang, K. Barmak, Y. Rabin, Y. and M. Asheghi, "High Resolution Heat Nano-Calorimetry," ASME International Mechanical Engineering Congress & Exposition, IMECE 2004-62105, November 13-19, Anaheim, CA, (2004).
45. (*Invited*) K. Barmak, W. E. Archibald, A. D. Rollett, S. Ta'asan, D. Kinderlehrer, "Grain Boundary Properties and Grain Growth: Al Foils, Al Films", in *Interfacial Engineering for Optimized Properties III*, edited by Christopher A. Schuh, Mukul Kumar, C. Barry Carter and Valerie Randle (Mater. Res. Soc. Symp. Proc. Volume 819, Warrendale, PA, 2004), 819-N06-06, 1-12 (2004).
44. A. Gungor, K. Barmak, A. D. Rollett, C. Cabral, Jr., and J. M. E. Harper, "Texture of Cu and dilute binary Cu(Ti) and Cu(In) thin films", *Materials Science Forum* (Trans. Tech. Publications, Switzerland) **408-412**, 1567-1572 (2002).
43. (*Invited*) K. Barmak, A. Gungor, A. D. Rollett, C. Cabral, Jr., and J. M. E. Harper, "Texture and resistivity of Cu and dilute Cu alloy thin films", *Mater. Res. Symp. Proc.* **721**, 51-59 (2002).
42. A. Gungor, K. Barmak, A. D. Rollett, C. Cabral, Jr., and J. M. E. Harper, "Cu and dilute binary Cu(Ti), Cu(Sn) and Cu(Al) thin films: texture, grain growth and resistivity", *Mater. Res. Symp. Proc.* **721**, 60-65 (2002).
41. S. K. Lorachoroensery, W. Z. Misiolek, F. G. Hanejko, K. S. Narasimhan, and K. Barmak, "Magnetic coating on iron powder for improved magnetic performance", *Proc. PM Conference*, (2000).
40. K. Barmak, G. A. Lucadamo, C. Cabral, Jr., C. Lavoie, and J. M. E. Harper, "Classification of the modes of dissociation in immiscible Cu-alloy thin films", *Mat. Res. Symp. Soc. Proc.* **564**, 341-346 (1999).
39. J. Kim, K. Barmak, L. H. Lewis, D. C. Crew, and D. O. Welch, "Magnetic exchange coupling in CoPt/Co bilayer thin films", *Mater. Res. Symp. Soc. Proc.*, **577**, 353-358 (1999).
38. R. A. Ristau, K. Barmak, L. H. Lewis, K. R. Coffey, and J. K. Howard, "A study on high coercivity and  $L1_0$  ordered phase in CoPt and FePt thin films", *Mater. Res. Symp. Soc. Proc.* **577**, 347-352 (1999).
37. G. Lucadamo, K. Barmak, D. T. Carpenter, C. Lavoie, C. Cabral, Jr., C. Michaelson, and J. M. Rickman, "Microstructure evolution during solid-state reactions in polycrystalline Nb/Al and Ti/Al multilayer thin films", *Mater. Res. Symp. Soc. Proc.* **562**, 159-164 (1999).
36. D. T. Carpenter, M. Watanabe, D. B. Williams, K. Barmak, and David A. Smith, "Measurement of Cu distribution in an Al-4 wt.% Cu thin film by analytical electron microscopy," *Boundaries and Interfaces in Materials*, Proceedings of The David A. Smith Symposium, Edited by R. C. Pond, W. A. T. Clark, and A. H. King, TMS, 199-204 (1998)
35. D. F. Susan, K. Barmak, A. R. Marder, "Morphological development of electrodeposited Ni-

Al particle composite coatings, advances in Coating Technologies of Surface Engineering, eds. C. R. Clayton, J. K. Hirvonen, and A. R. Srivatsa, (TMS, Warrendale, PA) 155-167 (1997).

34. R. A. Ristau, K. Barmak, K. R. Coffey, J. K. Howard, "L<sub>10</sub> phase formation in CoPt thin films", Mater. Res. Soc. Symp. Proc. **475**, 119-124 (1997).

33. G. Lucadamo, M. Watanabe, K. Barmak, and D. B. Williams, "High resolution x-ray microanalysis of Nb/Al multilayer thin films", Proc. Microscopy and Microanalysis 967-968 (1997).

32. D. T. Carpenter, M. Watanabe, K. Barmak, D. B. Williams, and D. A. Smith, "Quantification of Cu segregation to grain boundaries in an Al - 4 wt.% Cu thin film using high resolution x-ray mapping", Proc. Microscopy and Microanalysis '97, 537-538 (1997).

31. M. Watanabe, D. T. Carpenter, K. Barmak and D. B. Williams, "Quantitative x-ray mapping with high resolution", Proc. European Microscopy Congress, Inst. of Phys. Conf. Series, Series 153, Section 8, 295-298 (1997).

30. K. Barmak, S. W. Banovic, H. M. Chan, L. E. Friedersdorf, M. P. Harmer, A. R. Marder, C. M. Petronis, D. G. Puerta and D. F. Susan, "Processing and Properties of Electrodeposited Functionally Graded Composite Coatings of Ni-Al-Al<sub>2</sub>O<sub>3</sub>", Proc. of the 4th International Conference on Functionally Graded Materials, FGM '96, Oct. 21-24, Tsukuba, Japan, (Elsevier, Amsterdam 1997) pp. 227-232.

29. K. Barmak, S. W. Banovic, H. M. Chan, L. E. Friedersdorf, M. P. Harmer, A. R. Marder, C. M. Petronis, D. G. Puerta and D. F. Susan, "Electrochemical processing of layered composited coatings of nickel-aluminum-alumina/alumina-zirconia", Mater. Res. Soc. Symp. Proc., **451**, 469-474 (1997).

28. R.A. Ristau and K. Barmak, "Investigation of CoPt and CoPt + ZrO<sub>x</sub> thin films for magnetic storage media using high-resolution analytical electron microscopy", Proc. Microscopy and Microanalysis, 1020-1021 (1996).

27. F. Ma, S. Vivekanand, K. Barmak and C. Michaelsen, "Transmission electron microscopy studies of solid state reactions in Nb/Al multilayer thin films", Proc. Microscopy and Microanalysis, 1020-1021 (1996).

26. G. Lucadamo, K. Barmak and C. Michaelsen, "Characterization of reactive phase formation in sputter-deposited Ni/Al multilayer thin films using transmission electron microscopy, Proc. Microscopy and Microanalysis, 1000-1001 (1996).

25. S. W. Banovic, C. M. Petronis, K. Barmak and A. R. Marder, "Graded Ni-alumina coatings via electrodeposition", Proc. of Symp. Elevated Temp. Coating: Science and Technol., Edited by N. B. Dahotre and J. M. Hampikian, TMS 89-98 (1996).

24. (*Invited*) K. Barmak, C. Michaelsen, J. Rickman, M. Dahms, "Reactive phase formation in

- thin films: evolution of grain structure”, Mater. Res. Soc. Symp. Proc., **403**, 51-62 (1996)
23. R. Ristau, K. Barmak, D. Hess, K. R. Coffey, M. A. Parker and J. K. Howard, “Ordering and grain growth in CoPt thin films”, Mat. Res. Soc. Symp. Proc. **398**, 557-562 (1996).
22. K. Barmak, S. Vivekanand, F. Ma, C. Michaelsen, “Nucleation and growth of the first phase in sputter-deposited Nb/Al multilayer thin films”, Mater. Res. Soc. Symp. Proc. **398**, 257-262 (1996).
21. C. Michaelsen, S. Wöhlert, R. Bormann, K. Barmak, “The early stages of solid state reactions in Ti/Al multilayer films”, Mater. Res. Soc. Symp. Proc., **398**, 245-250 (1996).
20. G. Lucadamo, K. Barmak, C. Michaelsen, “Amorphous and crystalline phase formation in Ni/Al multilayer thin films”, Mater. Res. Soc. Symp. Proc. **398**, 227-232 (1996).
19. R. A. Ristau, K. Barmak, D. W. Hess, K. R. Coffey, J. K. Howard, “Grain growth kinetics in ordered Co-Pt thin films”, Proc. of the 29th annual conf. of the Microbeam Analysis Soc., 415-416 (1995).
18. V. Saikumar, K. Barmak, C. Michaelsen, “A study of reactive phase formation in sputter-deposited Nb-Al multilayer thin films”, Proc. of the 29th annual conf. of the Microbeam Analysis Soc., 413-414 (1995).
17. K. Barmak, C. Michaelsen, R. Bormann, G. Lucadamo, “Reactive phase formation in sputter-deposited Ni/Al thin films,” Mater. Res. Soc. Symp. Proc. **382**, 33-38 (1995).
16. K. R. Coffey, K. Barmak, “A unified approach to grain boundary diffusion and nucleation in thin film reactions”, Mater. Res. Soc. Symp. Proc. **343**, 193-204 (1994).
15. S. M. Lee, K. Barmak, "Amorphous/crystalline structure and phase transformation in metastable semiconducting  $\text{Ge}_{1-x}\text{Sn}_x$ ", Mater. Res. Soc. Symp. Proc. **321**, 313-318 (1994).
14. K. Barmak, "The use of TEM and AEM in studying reactions and phase transformations in thin films", Proceedings of the **51st** Annual Meeting of the Microscopy Society of America, 842-843 (1993).
13. (*Invited*) L. A. Clevenger, Q. Z. Hong, R. Mann, J. M. E. Harper, K. Barmak, C. Cabral, Jr., C. Nobili and G. Ottaviani, “Silicide formation in Ti-Si and Co-Si reactions”, Mater. Res. Soc. Symp. Proc. **311**, 253-264 (1993).
12. J. G. Holl-Pellerin, S. G. A. Anderson, P. S. Ho, K. R. Coffey, J. K. Howard, K. Barmak, "Grain boundary diffusion in Co/Cu and Co/Cr bilayer magnetic thin films”, Mater. Res. Soc. Symp. Proc. **313**, 205-210 (1993).
11. K. Barmak, K. R. Coffey, "Grain boundary diffusion controlled precipitation as a model for thin film reactions", Mater. Res. Soc. Symp. Proc. **311**, 51-56(1993).

10. L. A. Clevenger, Q. Z. Hong, J. M. E. Harper, C. Cabral, Jr., R. Mann, C. Nobili, G. Ottaviani, K. Barmak, "Silicide formation and transformations in Ti-Si, Co-Si and Ni-Si Reactions, Mater. Res. Soc. Symp. Proc. **311**, 253-258 (1993).
9. E. Ganin, S. Wind, P. Ronsheim, A. Yapsir, K. Barmak, J. Bucchignano, R. Assenza, "TiSi<sub>2</sub> formation on submicron polysilicon lines: role of line width and dopant concentration", Mater. Res. Soc. Symp. Proc. **303**, 109-114 (1993).
8. Q. Z. Hong, K. Barmak, L. A. Clevenger, "Effects of ion implantation on crystallization of amorphous CoSi<sub>2</sub>", Mat. Res. Soc. Symp. Proc. **279**, 541-546 (1993).
7. K. Barmak, L. E. Levine, D. A. Smith, Y. Komem, "In situ observation of C49 to C54 TiSi<sub>2</sub> transformation", Proceedings of the **50th** Annual Meeting of the Electron Microscopy Society of America, 1356-1357 (1992).
6. A. Mutscheller, L. A. Clevenger, J. M. E. Harper, C. Cabral Jr., K. Barmak, "Effect of deposition parameters on intrinsic stress, phase transformation and stress relaxation in thin Ta films, Mater. Res. Soc. Symp. Proc. **239**, 51-56 (1992).
5. K. Barmak, L. A. Clevenger, P. D. Agnello, E. Ganin, M. Copel, P. Dehaven, J. Falta, F. M. d'Heurle, C. Cabral Jr., "Effect of an interfacial Ti layer on the formation of CoSi<sub>2</sub> on Si", Mater. Res. Soc. Symp. Proc. **238**, 575-562 (1992).
4. K. Barmak, K. R. Coffey, D. A. Rudman, S. Foner, "Effect of microstructure on phase formation in the reaction of Nb/Al multilayer thin films", Mater. Res. Soc. Symp. Proc. **230**, 61-66 (1992).
3. K. R. Coffey, K. Barmak, D. A. Rudman, S. Foner, "First phase formation kinetics in the reaction of Nb/Al, Mater. Res. Soc. Symp. Proc. **230**, 55-60 (1992).
2. K. Barmak, K. R. Coffey, D. A. Rudman, S. Foner, "Characterization of phase formation in multilayer thin films of Nb/Al by cross-sectional transmission electron microscopy", Materials Research Society, Selected Topics in Electronics Materials, 267 (1988).
1. G. Yurek, K. Przybylski, K. Barmak, S. N. Basu, "Oxidation behavior of fine-grained rapidly solidified alloys", Corrosion '88, Paper No. 132, NACE, (1988).

## **IBM PUBLICATIONS**

9. K. Barmak, M. A. Lee, D. J. Schepis, K. Seshan, "An Instrument for Measurement of Pulsed Elements", IBM Technical Disclosure, rated publish.
8. Q. Z. Hong, K. Barmak, F. M. d'Heurle, "Formation of a C49 TiGe<sub>2</sub> phase during annealing a

coevaporated  $\text{Ti}_{0.33}\text{Ge}_{0.67}$  alloy", IBM Res. Report RC 18997(82973), (1993).

7. L. A. Clevenger, Q. Z. Hong, R. Mann, J. M. E. Harper, K. Barmak, C. Cabral, Jr., C. Nobili, G. Ottaviani, "TiSi<sub>2</sub> and CoSi<sub>2</sub> reactions for CMOS Applications", IBM Res. Report RC 18915(82599), (1993).

6. L. A. Clevenger, Q. Z. Hong, R. Mann, J. M. E. Harper, K. Barmak, C. Cabral, Jr., C. Nobili, G. Ottaviani, "Silicide formation Ti-Si and Co-Si Reactions", IBM Res. Report RC 18861(82599), (1993).

5. K. Barmak, J. Gambino, "Separation of Gate Salicidation from Source/Drain Salicidation", IBM Technical Disclosure Bulletin **34**, 474 (1992).

4. Q. Z. Hong, K. Barmak, L. Clevenger, "Composition dependence of crystallization of Co-Si alloys", IBM Res. Report RC 17931(78809), (1992).

3. A. Mutscheller, L. A. Clevenger, J. M. E. Harper, C. Cabral, K. Barmak, "Effect of deposition conditions on intrinsic stress, phase transformation, and stress relaxation in tantalum thin films", IBM Research Report RC 17546(77456), (1992).

2. K. Barmak, "Improved Fuses for VLSI Circuits", IBM Technical Disclosure Bulletin **34**, 399 (1991).

1. K. Barmak, R. Bennett, S. Subbanna, A. Yapsir, "Double Poly Improved NTX Transistor Structure", IBM Technical Disclosure Bulletin **34**, 323 (1991).

## **INTERNAL SERVICE ACTIVITIES – COLUMBIA UNIVERSITY**

### *University*

- Presidential Teaching Awards (2012), member
- Presidential Teaching Awards (2013), member
- Presidential Teaching Awards (2014), chair

### *College - SEAS*

- Undergraduate Curriculum Committee (2014-)
- Task Force on the Masters Program (2013-2014)
- Dean Search Committee (2012-2013)
- Tenure Workshop (January 25, 2012) – Participant giving advice to junior faculty
- SEAS Days on Campus, Master Class (April 19, 2013)  
Lessons from Materials Science and Engineering: The Electrical Resistivity of Nanometric Cu Films

### *Department*

- APAM Research Conference (Fall 2011)
- Chair, Faculty Search Committee (2011-2012)

## **INTERNAL SERVICE ACTIVITIES - CARNEGIE MELLON**

### *University*

- None

### *College - CIT*

- CIT Ad Hoc Promotion and Tenure Committee (2007)
- CIT Ad Hoc Promotion and Tenure Committee (2005)
- Department Head Search Committee, Mechanical Engineering (2005)
- Department Head Search Committee, Materials Science and Engineering (2005)
- Sigma Xi undergraduate research competition, Judge (2005)
- CIT Ad Hoc Promotion and Tenure Committee (2004)
- “Meeting of the Minds”, Judge (2002)
- CIT Awards Committee (2001)
- Department Head Search Committee, MSE (2000)
- “Meeting of the Minds”, Judge (2000)
- “Meeting of the Minds”, Judge (1999)

### *Department*

- Faculty Advisor, ASM Material Advantage Student Committee (2009-2011)
- Chair, Graduate Recruitment Committee (2006-2011)
- Chair, Departmental Seminar Committee (2006-2009)
- Undergraduate Curriculum Committee (2004-2011)
- Facilities Committee (2005-2006)
- Undergraduate Program Assessment and Review Committee (ABET) (2004-2005)
- GSAC Advisor (2003-2005)
- SAC Advisor (2000-2003)
- Undergraduate Affairs Committee (2001-2005)
- Graduate Affairs Committee (2001-2005)

### *Other*

- Director of Outreach Activities, Mesoscale Interface Mapping Project (MIMP), Materials Research Science and Engineering Center (MRSEC), Carnegie Mellon University (2000)

## **INTERNAL SERVICE ACTIVITIES - LEHIGH**

### *University*

- Provost’s Council (1998)
- Provost Search Committee (1996-97)
- Dean's Search Committee, Engineering and Applied Science (1994-95)
- Lehigh University Prestige Scholarship Committee (1992-1996)

### *College*

- Engineering College Student Retention Committee

### *Department*

- Search Committee, Loewy Chair, Department of Materials Science and Engineering (1996)
- Directed a \$250,000 renovation effort for thin film processing, ceramic processing (clean room), thin film characterization and electrochemical processing laboratories (1993-95)
- Faculty Coadvisor of the Departmental Student Materials Society (1995-1998)
- Sigma Xi, Departmental officer

### **EXTERNAL ACTIVITIES**

38. Meeting Co-Chair, 13<sup>th</sup> Joint Magnetism and Magnetic Materials and Intermag Conference 2016.
37. Judge, Tricounty Science Fair, April 2014.
36. Program Committee Member, Magnetism and Magnetic Materials Conference 2014 (July 2014).
35. Panel member, NSF SBIR/STTR grants, February 2014.
34. Program Committee Member, Magnetism and Magnetic Materials Conference 2013 (July 2013).
33. IEEE Magnetics Conference Executive Committee, (2013-present).
32. Program Committee Member, Magnetism and Magnetic Materials Conference 2011.
31. Member, IEEE Magnetics Society and the society representative to Women in Engineering (WIE) Committee. The latter is a committee of the IEEE Board of Directors (2011-2013).
30. Session Chair, Magnetism and Magnetic Materials Conference, November 2010.
29. International Materials Reviews Committee (2010-2013)
28. Panel member, NSF CAREER grants, October 2009.
27. Associate Editor, Journal of Electronic Materials (2007-2013).
26. Program Committee Member, Magnetism and Magnetic Materials Conference 2008 (July 2008).
28. Congressional Visit Day – Visiting the Staff of the Offices of Members of the House of Representatives and the Senate”, March 4, 5, 2008.
27. Chair, MO Physics and Devices II, MORIS, Pittsburgh, PA (2007).



26. Program Committee Member, Magnetism and Magnetic Materials Conference 2007 (July 2007).
25. Panel Member, Pre-proposals for Integrated Graduate Education and Research Program, NSF, June 2007.
24. Program Committee Member, 10<sup>th</sup> Joint Magnetism and Magnetic Materials and Intermag Conference 2007 (August 2006).
23. Member, Graduate Student Award Subcommittee of the Awards Committee, Materials Research Society, 2003-2005.
22. Program Committee Member, 50<sup>th</sup> Annual Conference on Magnetism and Magnetic Materials 2005.
21. Judge, Graduate Student Award, Materials Research Society, April 2004.
20. Panel Member, NSF-EU grants, January 2004.
19. Panel member, NSF CAREER grants, October 2002.
18. Member, Nominations Committee, Materials Research Society, 2001.
17. Site Review Panel Member, Harvard University National Science Foundation Materials Research Science and Engineering Center (NSF MRSEC), Spring 2001.
16. Meeting Chair, Materials Research Society, Spring 1999.
15. Elected Member of Board of Directors (i.e., Council), Materials Research Society, (1998-2000).
14. Member, Student Affairs Committee, The Minerals, Metals, Materials Society (1998-2000).
13. Judge, Graduate Student Award, Materials Research Society, December 1997.
12. Reviewer, NSF CAREER grants, October 1997.
11. Symposium Organizer, Materials Research Society Symposium M - "Magnetic Ultrathin Films, Multilayers and Surfaces", April 1997.
10. Panel member, NSF instrumentation grants, January 1997.
9. Panel member, NSF CAREER grants, January 1997.
8. Chair, Membership Committee, Materials Research Society (1996-1998).

7. Committee of Visitors, National Science Foundation (NSF), April 1996.
6. Panel member, NSF instrumentation grants, January 1995.
5. Chair, Promotion and Retention Subcommittee of the Membership Committee, Materials Research Society (1994-95).
4. Symposium Organizer, Materials Research Society Symposium H - "Polycrystalline Thin Films: Structure, Texture, Properties and Applications", April 1994.
3. International Advisory Committee member for Functionally Graded Materials (1994-1999)
2. Judge, Lehigh Valley Science and Engineering Fair, March 1994.
1. Reviewer for:
 

NSF	DoE	CRDF
J. Materials Research	Acta Materialia	J. Appl. Phys.
Metall. Transactions	Applied Physics Letter	Thin Solid Films
J. Mater. Sci.	Mater. Res. Bulletin	J. Vac. Sci. Technol.
J. Physics	Mater. Sci. Eng.	J. Electrochemical Soc.

**INVITED TALKS, PROJECT REVIEW PRESENTATIONS (Partial)**

- 82.
- 83.
81. "Grain Growth and the Puzzle of its Stagnation in Metallic Films: Experiment, Simulation and Analytic Theory", TMS Conference, Orlando, FL, March 15-19, 2015.
80. "Grain Growth and Grain Growth Stagnation in Metallic Films: The Curious Tail of a Tale and an Ear", The Courant Institute, New York University, November 2014.
79. (*Plenary Lecture*) "Grain Growth and Grain Growth Stagnation in Thin Films: The Curious Tale of a Tail and an Ear", Continuum Models Discrete Systems, University of Utah, Salt Lake City, UT, July 21-25, 2014.
78. "Grain Boundary and Surface Scattering in Interconnect Metals", Rensselaer Polytechnic Institute, February 2014.
77. "Grain Boundary and Surface Scattering in Interconnect Metals", IBM, Albany, October 2013.

76. "Impact of Grain Boundary and Surface Scattering on Resistivity", Advanced Metallization Conference 2013, College of Nanoscale Science and Engineering, SUNY, Albany, October 2013.
75. (*Plenary Lecture*) "The A1 to L1<sub>0</sub> Transformation in FePt, FeNi and Related Alloys", International Symposia on Metastable Amorphous and Nanocrystalline Materials (ISMANAM), Turin, Italy, July 2013.
74. L1<sub>0</sub> FePt: Ordering, Anisotropy Constant and their relation to Film Composition, 12<sup>th</sup> joint InterMag and Magnetism and Magnetic Material Meeting, Chicago, Illinois, January 2013.
73. "Grain Growth and the Puzzle of its Stagnation in Thin Films: Comparison of Experiments and Simulations", Institute for Pure and Applied Mathematics, University of California, Los Angeles, November 2012.
72. "Surface and Grain Boundary Scattering in Nanometric Cu Films: A Quantitative Analysis Including Twin Boundaries", Case Western Reserve University, Cleveland, OH, November 2011.
71. "Surface and Grain Boundary Scattering in Nanometric Cu Films: A Quantitative Analysis Including Twin Boundaries", Rutgers University, New Brunswick, NJ, November 2011.
70. "Surface and Grain Boundary Scattering in Nanometric Cu Films: A Quantitative Analysis Including Twin Boundaries", EFRC presentation, Columbia University, NY, November 2011.
70. "Mapping Nanoscale Structures", Dean's Advisory Council, Carnegie Institute of Technology, Carnegie Mellon University, Pittsburgh, PA, April 2011.
69. Quantitative Kinetic Models and Experiments of L1<sub>0</sub> Formation in FePt, CoPt and Related Alloy Films", Information Storage Industry Consortium Meeting, Santa Clara, CA, January 2011.
68. "Classical Resistivity Size Effect: Surface and Grain Boundary Scattering in Cu Thin Films and Lines", Mesoscale Interface Mapping Project Seminar, Pittsburgh, PA, December 2010.
67. Quantitative Kinetic Models and Experiments of L1<sub>0</sub> Formation in FePt, CoPt and Related Alloy Films", Information Storage Industry Consortium Meeting, Milpitas, CA, August 2010.
66. (*Outreach*) Research Experience for Undergraduate Summer Professional Development Series,
65. "Orientation Mapping in the Transmission Electron Microscope", Mesoscale Interface Mapping Project Summer School, Pittsburgh, PA June 2010.
64. Quantitative Kinetic Models and Experiments of L1<sub>0</sub> Formation in FePt, CoPt and Related Alloy Films", Pittsburgh, PA, May 2010.

63. "Thermodynamics and Kinetics of L1<sub>0</sub> Phase Formation in FePt and Related Ternary Alloys", IFW Dresden, Germany, April 2010.
62. "Experimental Studies on Interfacial and Grain Boundary Scattering in Cu, 11<sup>th</sup> International Workshop on Stress Induced Phenomena in Metallization", Bad Schandau, Germany, April 2010.
61. Quantitative Kinetic Models and Experiments of L1<sub>0</sub> Formation in FePt, CoPt and Related Alloy Films", Information Storage Industry Consortium Meeting, Berkeley, CA, January 2010.
60. "Heat-Assisted Magnetic Recording: The Kinetics and Thermodynamics of L1<sub>0</sub> Formation in FePt and Related Ternary Alloys", David Laughlin Symposium, MS&T Conference, Pittsburgh, October 2009.
59. "Grains, Grain Growth and the Impact of Grain Boundaries on Electrical Resistivity", Columbia University, June 2009.
58. "Lessons from Materials Science: Dominant role of Grain Boundary Scattering in the Resistivity of Encapsulated Cu Films", Physics Colloquium, Carnegie Mellon University, May 2009.
57. "L1<sub>0</sub> Alloys for HAMR Media: On the Nucleation of the L1<sub>0</sub> phase", Seagate Research, April 2008.
56. "Grain Growth and the Puzzle of its Stagnation in Thin Films: The Tale of a Tail and an Ear?", California Institute of Technology, March 2008.
55. "L1<sub>0</sub> Ordered Intermetallics for Ultrahigh Density Magnetic Recording Media: Phase Formation and the Role of Alloy Chemistry and Composition", Materials Research Society Conference, Boston November 2006.
54. "Resistivity of Sub-45 nm Cu Interconnects: Processing, Transport, and Microstructural Characterization – 1292.008", SRC CAIST Back End Workshop, SUNY, Albany, May 2006.
53. "The A1 to L1<sub>0</sub> transformation in FePt, FeCuPt and FeNiPt", Seagate Research, April 2006.
52. "An Old Problem, A New Approach: Grain Boundary Properties and Grain Growth", University of Central Florida, Orlando, May 2005.
51. "An Old Problem, A New Approach: Grain Boundary Properties and Grain Growth", Boston University, Boston, March 2005.
50. "Microstructural design of polycrystalline materials: nucleation and growth, grain growth" Plasticity Conference, Kauai, January 2005.

49. "Grain boundary properties and grain growth: Al Foils, Al Films", Materials Research Society Conference, San Francisco, April 2004.
48. "Calorimetric studies of the A1 to L<sub>10</sub> transformation in FePt and related ternary alloys", Seagate Research, November 2003.
47. "Calorimetric studies of the A1 to L<sub>10</sub> phase transformation in FePt and CoPt", Seagate Research, July 2003.
46. "Cu and Cu-alloy thin films: resistivity, texture and grain structure", Interconnect Technology Seminar, IBM T. J. Watson Research Center, July 2003.
45. "Cu and Cu-alloy thin films", IBM T. J. Watson Research Center, April 2003.
44. "Cu and Cu-alloy thin films: resistivity, texture and grain structure", Materials Research Society Conference, San Francisco, April 2003.
43. "Differential scanning calorimetry: thin film reactions and phase transformations", IBM T. J. Watson Research Center, September 2002.
42. "Texture and resistivity of Cu and dilute Cu alloy thin films", Materials Research Society Conference, San Francisco, April 2002.
41. "Differential scanning calorimetry", Seagate, Minneapolis, February 2002.
40. "Phase transformations in polycrystalline thin films: experiment, theory and simulation", Columbia University, March 2001.
39. "Ordering and grain growth in CoPt and FePt thin films", IBM Almaden Research Center, February 2001.
38. "Magnetic Signature of compositional gradient in exchange spring bilayer thin films of CoPt/Co", Brookhaven National Laboratory, January 2001.
37. "High anisotropy constant materials for magnetic recording media: L<sub>10</sub> ordering and grain growth in CoPt and FePt thin films", Data Storage Systems Center, Carnegie Mellon University, September 2000.
36. "Dissociation of dilute copper alloys", IBM T. J. Watson Research Center, August 2000.
35. "Grain growth and ordering in CoPt and FePt thin films", Seagate Technology Lab, Pittsburgh, July 2000.
34. "Experimental and theoretical studies of thin film reactions", Indiana University of Pennsylvania, February 2000.

33. "Thin film reactions", Department of Chemical Engineering, Carnegie Mellon University, October 1999.
32. "Phase Transformations in Thin Metal Films", Naval Research Laboratory, Washington, DC, October 1999.
31. "Phase transformations and mechanical behavior of metal thin films and multilayers", University of Pittsburgh, Department of Mechanical Engineering, October 1999.
30. "Semiconductor Metallization: Phase Transformations in Thin Films", University of Pittsburgh, Department of Materials Science and Engineering, September 1999.
29. "Thin films", Seminar Series, Carnegie Mellon University, September 1999.
28. "Nucleation and growth in thin film reactions: microstructural implications", Rensselaer Polytechnic Institute, March 1999.
27. "Grain structure evolution in thin film reactions", Case Western Reserve University, April 1998.
26. "Evolution of grain structure in thin film reactions", Carnegie Mellon University, March 1998.
25. "Contact metallization and the solid state reaction of thin films", Princeton University, January 1998.
24. "Evolution of grain structure in thin film reactions", Penn State, October 1997.
23. "Role of grain boundaries and interfaces in thin film reactions", Boundaries and Interfaces in Materials: The David A. Smith Memorial Symposium, TMS/ASM Meeting, Indianapolis, IN, Sept. 15,-18, 1997.
22. "Ultrasonic characterization of particles in electrochemical deposition baths," presented at the work shop on Ultrasonic and Dielectric Characterization Techniques for Suspended Particulates, NIST, Gaithersburg, MD, August 4-6, 1997.
21. "Role of interfaces and grain boundaries in thin film reactions", SUNY, Albany, NY, March 1997.
20. "Evolution of grain structure in thin film reactions", Johns Hopkins University, Baltimore, MD, March 1997.
19. "Evolution of grain structure in thin film reactions", II. Fabrication of thermal barrier coatings by electrochemical methods", SUNY, Stony Brook, NY, March 1997.
18. "Evolution of grain structure in thin film reactions, TMS conference, Orlando, Florida, Feb.

10-14, 1996.

17. "Reactive phase formation in thin films: evolution of grain structure," Cambridge University, England, June 1996.

16. "Reactive phase formation in thin films: evolution of grain structure," University of Manchester, England, June 1996.

15. "Reactive phase formation in thin films: evolution of grain structure," Department of Mechanical, Industrial and Manufacturing Engineering, Northeastern University, Boston, MA, May, 1996.

14. "Electrodeposited functionally graded composite coatings", Microscopy of Composite Materials III, Organized by the Royal Microscopical Society, Oxford, England, April 1996.

13. "Tailoring of silicides and aluminides for metallization in microelectronics, ISHM local meeting, Lehigh University, February 1996.

12. "Reactive phase formation in thin films: evolution of grain structure", Fall meeting of the Materials Research Society, Boston, MA, December, 1995.

11. "Metal films and coatings", Sigma Xi luncheon meeting, Lehigh University, November 1994.

10. "Reactive phase formation at interfaces", Department of Chemistry, Lehigh University, November, 1994.

9. "Metal films and coating", Department of Chemistry, Lehigh University, June, 1994.

8. "Solid-state reactions in thin films", Johns Hopkins University, October 1994.

7. "Reactive phase formation at interfaces", University of Konstanz, Germany, August, 1994

6. "Reactive phase formation at interfaces", GKSS Research Center, Geesthacht, Germany, July, 1994.

5. "Metal films and coatings", Lawrence University, Wisconsin, February, 1994.

4. "The use of transmission and analytical electron microscopy in studying reactions and phase transformations in thin films", Microscopy Society of America, August, 1993.

3. "Role of grain boundary diffusion in thin film reactions", AT&T, December, 1992.

2. "Phase formation in the reaction of multilayer thin films of Nb/Al", Stevens Institute of Technology, Department of Materials Science and Engineering, February, 1991.

1. "Phase formation in the reaction of Nb/Al multilayers: a new theory of thin film reaction kinetics", Brookhaven National Laboratory, April, 1991.

## **PARTIAL LIST OF CONFERENCES ATTENDED**

68. TMS Conference, Orlando, FL, March, 2015
67. American Vacuum Society Conference, Baltimore, MD, November 2014.
66. Magnetism and Magnetic Materials, Denver, CO, November 2013.
65. Advanced Metallization Conference, College of Nanoscale Science and Engineering, October 2013.
64. Microscopy and Microanalysis Meeting, Indianapolis, IN, August 2013.
63. International Symposia on Metastable Amorphous and Nanocrystalline Materials (ISMANAM), Turin, Italy, July 2013.
62. Materials Research Society Meeting, San Francisco, April 2013.
61. Magnetism and Magnetic Materials/Intermag, Chicago, IL, January 2013.
60. IPAM, UCLA, CA, November 2012.
59. Magnetism and Magnetic Materials, Scottsdale, AZ, October 2011.
58. Advanced Storage Technology Consortium Meeting, Santa Clara, CA, January 2011.
57. Magnetism and Magnetic Materials, Atlanta, GA, November 2010.
56. MS&T, Houston, TX, October 2010.
55. Information Storage Industry Consortium Meeting, Milpitas, CA, August 2010.
54. Microscopy and Microanalysis Meeting, Portland, OR, August 2010.
53. Recrystallization and Grain Growth Conference, Sheffield, UK, July 2010.
55. Information Storage Industry Consortium Meeting, Pittsburgh, PA, May 2010.
52. 11<sup>th</sup> International Workshop on Stress Induced Phenomena in Metallization, Bad Schandau, Germany, April 2010.
55. Information Storage Industry Consortium Meeting, Berkeley, CA, January 2010.



51. MS&T, Pittsburgh, PA, October 2009.
50. Microscopy and Microanalysis, Richmond, VA, August 2009.
49. Materials Research Society Meeting, San Francisco, April 2009.
48. Magnetism and Magnetic Materials, Austin, TX, November 2008.
47. MS&T, Pittsburgh, PA, October 2008.
47. International Conference on the Texture of Metals, ICOTOM 15, Pittsburgh, PA, June 2008.
46. Magnetism and Magnetic Materials, Tampa, FL, November 2007.
45. MORIS conference, Pittsburgh, PA, September 2007.
44. The 10<sup>th</sup> joint Intermag/MMM conference, Baltimore, MD, January 2007.
43. Materials Research Society Meeting, Boston, November 2006.
42. Semiconductor Research Corporation Back End Processing Workshop, SUNY Albany, NY, May 2006.
41. Magnetism and Magnetic Materials, San Jose, CA, October 2005.
40. MS&T, Pittsburgh, September 2005.
39. International Conference on the Texture of Metals, ICOTOM 14, Leuven, Belgium, July 2005.
38. Cu Resistivity Workshop, San Jose, CA, June 2005.
37. TMS, 134<sup>th</sup> Annual Meeting and Exhibition, San Francisco, CA, February 2005.
36. Plasticity Conference, Kauai, HI, January 2004.
35. L1<sub>0</sub> Ordered Intermetallic and Related Phases for Permanent Magnet and Recording Applications, Copper Mountain, CO, August 2004.
34. Materials Research Society, San Francisco, CA, April 2004.
33. The 9<sup>th</sup> joint Intermag/MMM conference, Anaheim, CA, January 2004.
32. Materials Research Society, San Francisco, CA, April 2003.

31. InterMag 2002, Amsterdam, April-May 2002.
30. Materials Research Society, San Francisco, CA, March-April 2002.
29. Materials Research Society, San Francisco, CA, April 2001.
28. The 8<sup>th</sup> joint InterMag/MMM conference, San Antonio, TX, January 2001.
27. Materials Research Society, San Francisco, CA, April 2000.
26. Materials Research Society, Boston, MA, November -December, 1999.
25. Materials Research Society, San Francisco, CA, April, 1999.
24. Materials Research Society, San Francisco, CA, April, 1998.
23. Materials Research Society, Boston, MA, December, 1997.
22. The Minerals, Metals, Materials Society, Orlando, Indianapolis, September, 1997.
21. Workshop on Ultrasonic and Dielectric Characterization Techniques for Suspended Particulates, NIST, Gaithersburg, MD, August 4-6, 1997.
20. The Minerals Metals Materials Society, Orlando, Florida, February, 1997.
19. Materials Research Society, Boston, MA, December, 1996.
18. Fourth International Symposium on Functionally Graded Materials, Tsukuba, Japan, October, 1996.
17. Microscopy and Microanalysis 1996, Minneapolis, MN, August, 1996.
16. The 11th International Congress on Thermal Analysis and Calorimetry, Philadelphia, PA, August, 1996.
15. Materials Research Society, San Francisco, CA, April, 1996.
14. The Microscopy of Composites III, Oxford, England, April, 1996.
13. Materials Research Society, Boston, MA, December, 1995.
12. Magnetism and Magnetic Materials, Philadelphia, PA, November, 1995.
11. The Young Investigator meeting, White Oaks, CA, October, 1995.
10. NIST workshop on nanoscale structural materials, Gaithersburg, August 1995.

9. Microbeam Analysis Society 1995, Breckenridge, CO, August, 1995.
8. Ceramic Society Meeting, Cincinnati, OH, April, 1995.
7. Materials Research Society, San Francisco, CA, April 1995.
6. Functionally Gradient Materials III, Lausanne, Switzerland, October, 1994.
5. Materials Research Society, San Francisco, CA, October 1994.
4. International Symposium on Mechanisms of Formation of Metastable Microstructures, Cambridge, U.K., July, 1993.
3. Materials Research Society, San Francisco, CA, April, 1993.
2. The Metals, Materials, Minerals Society Meeting, October, 1992.
1. Microscopy Society of America, Boston MA, August, 1992.

**CONFERENCE PRESENTATIONS (without an accompanying proceedings' paper)**

25. A. P. Warren, B. Yao, T. Sun, K. Barmak, M. F. Toney<sup>3</sup>, and K. R. Coffey, "X-ray Scattering Study of Interface Evolution and Grain Growth in Encapsulated Cu Films" Materials Research Society Spring Meeting, San Francisco, April 2009.
24. T. Sun, B. Yao, A. P. Warren, D. Choi, K. Barmak, M. F. Toney, R. E. Peale, and K. R. Coffey, "Dominant Role of Grain Boundary Scattering in the Resistivity of Encapsulated Cu Films", Materials Research Society Spring Meeting, San Francisco, April 2009.
23. K. Barmak, A. Darbal, T. Nuhfer, D. J. Dingley, G. Meaden, J. Michael, T. Sun, K. R. Coffey, "Orientation Imaging of Nanocrystalline Copper and Platinum Films in the Transmission Electron Microscope", Materials Research Society Spring Meeting, San Francisco, April 2009.
22. A.D. Rollett, K. Barmak, and B. Radhakrishnan, "Simulation of Interconnect Microstructures", Materials Research Society Spring Meeting, San Francisco, April 2009.
21. K. Barmak, D. C. Berry, J. M. Rickman, "L1<sub>0</sub> Alloys for Heat Assisted Magnetic Recording (HAMR) Media: On the Nucleation of the L1<sub>0</sub> Phase in FePt and FeCuPt Alloy Films", Magnetism and Magnetic Materials Conference, Austin, TX, November 2008.
20. K. Barmak, D. C. Berry, B. Wang, "Determination of the Long Range Order Parameter in Fiber-Textured Films of L1<sub>0</sub> FePt", International Conference on the Texture of Metals, ICOTOM 15, Pittsburgh, PA, June 2008.

19. D. C. Berry, B. Wang, K. Barmak, T. J. Klemmer, "L<sub>10</sub> FePt for Ultrahigh Density Magnetic Recording Media: Heats of Formation of the Ordered Intermetallics in the Fe-Pt System", Magnetism and Magnetic Materials, Tampa, FL, November 2007.
18. Heat Assisted Magnetic Recording Media: L<sub>10</sub> FePt and the Impact of Ternary Additions of Cu and Ni on the Curie Temperature and the Ordering Transformation", MORIS conference, Pittsburgh, PA, September 2007.
17. K. Barmak, J. Kim, C.-S. Kim, W. E. Archibald, G. Rohrer, A. D. Rollett, S. Ta'asan, D. Kinderlehrer, H. Zhang, D. J. Srolovitz, "Grain boundary energy and grain growth in <111> fiber-textured Al films", MS&T, Pittsburgh, September 2005.
16. K. Barmak, J. Kim, C.-S. Kim, G. S. Rohrer, H. Zhang, D. Srolovitz, "Grain boundary energy as a function of misorientation in <111> fiber-textured Al films: Experiment and simulation", TMS, San Francisco, February 14-18, 2005.
15. K. Barmak, W. E. Archibald, A. D. Rollett, S. Ta'asan, D. Kinderlehrer, "Microstructural design of polycrystalline materials: nucleation and growth, grain growth", Plasticity 2005, Kauai, HI, January 2005.
14. K. Barmak, "Calorimetric studies of the Al to L<sub>10</sub> phase transformation in binary FePt and ternary FeCuPt and FeNiPt thin films", L<sub>10</sub> Ordered Intermetallic and Related Phases for Permanent Magnet and Recording Applications, Copper Mountain, CO, August 2004.
13. K. Barmak, J. Kim, D. C. Berry, K. W. Wierman, E. B. Svedberg and J. K. Howard, "Calorimetric Studies of the Al to L<sub>10</sub> Transformation in FePt and Related Ternary Alloy Thin Films", The 9<sup>th</sup> joint Intermag/MMM conference, Anaheim, CA, January 2004.
12. K. Barmak, J. Kim, L. H. Lewis, K. R. Coffey, M. F. Toney, A. J. Kellock and J.-U. Thiele "Stoichiometry – Anisotropy Connections in Epitaxial L<sub>10</sub> FePt(001) Films", The 9<sup>th</sup> joint Intermag/MMM conference, Anaheim, CA, January 2004.
11. K. Barmak, "Reactive phase formation in thin films: evolution of grain structure", DIFTRANS '98, Cherkasy, Ukraine.
10. C. Michaelsen, G. Lucadamo, K. Barmak, "Sequence of phase formation in the reaction of Ni/Al multilayer thin films", presented at the Materials Research Society Meeting, Boston, MA, December 1-5, 1997.
9. G. Lucadamo, K. Barmak, C. Michaelsen, J. Rickman, S. Tong, J. Codner, "Reactive phase formation and product grain size in Nb/Al multilayer thin films", presented at the Materials Research Society Meeting, Boston, MA, December 1-5, 1997.
8. K. Barmak, "Role of grain boundaries and interfaces in thin film reactions", Boundaries and Interfaces in Materials: The David A. Smith Memorial Symposium, TMS/ASM Meeting, Indianapolis, IN, Sept. 15-18, 1997.

7. K. Barmak, "Ultrasonic characterization of particles in electrochemical deposition baths," presented at the work shop on Ultrasonic and Dielectric Characterization Techniques for Suspended Particulates, NIST, Gaithersburg, MD, August 4-6, 1997.
6. K. Barmak, S. Banovic, H. M. Chan, L. Friedersdorf, M. P. Harmer, A. M. Marder, C. M. Petronis, D. Puerta, D. Susan, "Functionally graded electrodeposited thermal barrier coatings", The Metals, Materials, Minerals Meeting, Orlando, FL, Feb. 10-14, 1997.
5. G. Lucadamo, K. Barmak, C. Michaelson, "Intermetallic Phase Formation in Nanoscale Ni/Al Multilayers, NIST workshop on nanoscale structural materials, Gaithersburg, MD. August 1995.
4. K. Barmak, C. Petronis, S. Banovic, A. R. Marder, "Fabrication of Functionally Graded Metal-Ceramic Coatings by electrodeposition", American Ceramic Society, Cincinnati, OH, April 1995.
3. K. Barmak, "Mechanisms of grain structure development in the reaction of polycrystalline thin films", presented at the International Symposium on Mechanisms of Formation of Metastable Microstructures, Cambridge, U.K., July 1993.
2. K. Barmak, K. R. Coffey, D. A. Rudman, and S. Foner, "Characterization of intermetallic phase formation in multilayer thin films of Nb/Al by cross-sectional transmission electron microscopy", presented at the Annual Meeting of The Metallurgical Society, Las Vegas, NV, February 1989.
1. K. R. Coffey, K. Barmak, D. A. Rudman, and S. Foner, "Investigation of Nb/Al Diffusion Reactions by Scanning Calorimetry in Thin Film and Powder Metallurgy Processed Samples", presented at the Annual Meeting of The Metallurgical Society, Las Vegas, NV, February 1989.

<b>GRADUATE STUDENTS</b>	<b>DEGREE</b>	<b>YEAR</b>	<b>UNIVERSITY</b>
31. Emi Leung Co-advisor with Prof. R. Farrauto (EEE)	Ph.D.	2016, expected	Columbia (EEE)
31. Jiaying Liu	Ph.D.	2016, expected	Columbia
30. Xuan Liu Title: Electron Diffraction-Based Metrology of Nanocrystalline Materials	Ph.D.	2013	CMU
29. Xuan Liu	M.S.	2011	CMU
28. Dooho Choi Title: Tungsten as a Next-generation Interconnect Metal in Semiconductor Devices	Ph.D.	2011	CMU

27. Amith Darbal                      Ph.D.        2011                      CMU  
 Title: Surface and Grain Boundary Scattering in Nanometric Cu Films: A Quantitative Analysis including Intra-grain Boundaries
26. Bincheng Wang                      Ph.D.        2011                      CMU  
 Title: Ultrahigh Density Magnetic Recording Media: Kinetic Experiments and Models of the A1 to L1<sub>0</sub> Phase Transformation in FePt and Related Ternary Alloy Films
25. Bincheng Wang                      M.S.        2008                      CMU
24. Vineet Kumar                      M.S.        2007                      CMU
23. David C. Berry                      Ph.D.        2007                      CMU  
 Title: Ultrahigh Density Magnetic Recording Media: The A1 to L1<sub>0</sub> Phase Transformation in FePt and Related Ternary Alloy Films
22. Shu Zhang                      Ph.D.        2007                      CMU  
 (Mechanical Engineering)
21. David C. Berry                      M.S.        2006                      CMU
20. Wayne Archibald                      Ph.D.        2004                      CMU  
 Title: Microstructural Characterization of Al Thin Films and Foils: grain growth, grain boundary topology and statistics
19. Sukbin Lee                      M.S.        2003                      CMU
18. Iung-Hsin Hsieh                      M.S.        2003                      CMU
17. Chando Park                      M.S.        2002                      CMU
16. Ali Gungor                      Ph.D.        2002                      CMU  
 Title: Cu and Cu Alloy Thin Films: Evolution of Resistivity and Microstructure
15. Jihwan Kim                      Ph.D.        2001                      Lehigh
14. Srinivasan Kumar                      M.S.        2000                      CMU
13. Gene A. Lucadamo                      Ph.D.        2000                      Lehigh  
 Title: A Study of the Kinetics and Microstructure Evolution during Reactions of Niobium/Aluminum and Titanium/Aluminum Multilayer Thin-Films
12. W. Scott Tong                      Ph.D.        2000                      Lehigh
11. Hyungwook Kim                      M.S.        1999                      CMU

10. Derrick T. Carpenter	Ph.D.	1998	Lehigh
9. Roger A. Ristau	Ph.D.	1998	Lehigh
Title: Microstructural and Magnetic Characterization of CoPt and FePt Thin Films			
8. Balaji Gadicharla	M.S.	1997	Lehigh
7. Douglas Puerta	M.S.	1997	Lehigh
6. Gene A. Lucadamo	M.S.	1996	Lehigh
5. W. Scott Tong	M.S.	1996	Lehigh
4. Cindy M. Petronis	M.S.	1996	Lehigh
3. Ellen Youngblood	M.S.	1995	Lehigh
2. Roger A. Ristau	M.S.	1995	Lehigh
1. Lance Muzslay	M.S.	1994	Lehigh

#### **MASTERS STUDENT SCIENCE REPORTS – COLUMBIA UNIVERSITY**

13. Peng Yue	Fall 2015
12. Qi Zhou	Fall 2015
11. Nadezhda Khapochkina	Spring, Summer 2015
10. Qiyuan Lin	Spring, Summer, Fall 2015
9. Fernando Concalves-Neto	Spring, Summer, Fall 2015
8. Wendi Cheng	Spring 2014
7. Haoming Lu	Spring 2014
6. Hao Duan	Spring 2014
5. Yiwei Jin	Fall 2013
4. Jingjing Ling	Fall 2013
3. Zhaoyi Li	Spring 2012

2. Ying Wang                      Spring 2012

1. Yiran Lu                         Spring 2012

<b>UNDERGRADUATE STUDENTS</b>	<b>YEAR</b>	<b>UNIVERSITY</b>
34. Christina Floristean	2014	Columbia
33. Lauren Riddiford	2014	Columbia
32. Sloka Gundala	2014	Columbia
31. David Schutzman	2011	CMU
30. Justin Dersh	2009	CMU
29. Andrew Jesanis	2009	CMU
28. Shannon Andersen	2008	FSU/CMU
27. Anthony Rice	2008	CMU
26. Alexander Hansen	2008	CMU
25. Scott Roberts	2007	CMU
24. Terry Shyu	2007-08	CMU
23. Hanness Eggenschwiller	2006	CMU/EPFL
22. Mitchell Kosowski	2006	CMU
21. Nelson Cheung	2006	CMU
20. Ysela Chiari	2005	FAMU/CMU
19. Benjamin Nowak	2005	CMU
18. Laura Pritchard	2004	CMU
17. Velouse Pierre	2004	FAMU/CMU
16. Wan Nurul Hanani Wan Alkamar Shah	2003	CMU



15. Ernestine Lowery	2002	FAMU/CMU
14. Lauren Casey	2002	FAMU/CMU
13. Autumn Wyda	2002	CMU
12. Antoine Beret	2000	FAMU/CMU
11. Mitra Taheri	1999	CMU
10. Mathew Walker	1999	Alfred/CMU
9. Michael Carone	1998	Lehigh
8. Sarah Phillips	1998	Lehigh
7. Joleen Codner	1996-1998	Lehigh
6. Richard Noecker	1996	Lehigh
5. Valerie Liu	1995	Rice/Lehigh
4. Shannon Reaney	1995	Lehigh
3. Megan Slusser	1995	Lehigh
2. Steven Banovic	1994	Lehigh
1. Kevin Johnson	1994	Lehigh

<b>POST DOCTORAL ASSOCIATES</b>	<b>YEAR</b>	<b>UNIVERSITY</b>
11. Nader Zaki	2015	Columbia
10. Bincheng Wang	2011	Columbia
9. Shanling Wang	2006	CMU
8. Romyana Petrova	2006-08	CMU
7. Jihwan Kim	2001-04	CMU
6. W. Scott Tong	2000	CMU
5. Gene Lucadamo	2000	Lehigh

4. Lisa Friedersdorf	1996-98	Lehigh
3. Guobin Zhang	1995	Lehigh
2. Saikumar Vivekanand	1994	Lehigh
1. Brian Smith	1993	Lehigh

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