

## **BHASKAR S. MAJUMDAR**

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### **PRINCIPAL EDUCATION INTERESTS**

I find interest in educating students in the broad area of mechanics of materials, with the aim of relating their crystallography and microstructure to macroscopic mechanical properties, and in teaching about manufacturing methods and laboratory techniques. Also, my interest is to guide graduate and undergraduate students in diligent laboratory practices and analytical reasoning and skill development.

### **EDUCATION**

Ph.D.            Mat. Sc. Program, Dept. of Mech. Engg., Univ. of Rochester, NY - 14627 (1981)  
M.E.            Mechanical Engineering, Indian Institute of Science, Bangalore, India (1975)  
B.Tech.        Mechanical Engineering, Indian Institute of Technology, Kanpur, India (1972)

### **PRINCIPAL RESEARCH INTERESTS**

To obtain a fundamental understanding of how the deformation and fracture processes in materials are related to their microstructure. The approach includes a strong blend of experimental techniques and analytical/FEM modeling, to identify and understand unit processes. The materials of interest are metals, composites, polymers, coatings, and interfaces.

#### **Ongoing and Recent Projects at New Mexico Tech:**

- (i) Anisotropic deformation behavior and microstructural evolution in single crystal Ni-base superalloys, with emphasis on microstress measurements (using neutron diffraction) and modeling (dislocation/crystal-plasticity-FEM) of the nano-scale  $\gamma/\gamma'$  microstructure. In this regard, note that single crystal superalloys are indeed excellent materials for understanding and modeling stress evolution and the kinetics of microstructural change of nanoscale microstructures under high constraint. (*NSF-DMR, current*)
- (ii) Deformation behavior of fine-grained high temperature Al-alloys based on Al-Y-Ni system, starting from an initial amorphous phase. Focus on microstructure evolution through texture and grain/precipitate growth measurements (texture, HRTEM, Rietveld refinement of XRD), and relation to strength and ductility using analytical and crystal-plasticity based FEM methods. The work also involves fracture toughness and fatigue crack growth measurements utilizing electric potential and COD techniques. (*DARPA, SAM initiative, just completed*)
- (iii) Understanding texture development in shape memory alloys (SMA), both NiTi type, as well as advanced ferromagnetic shape memory alloys (FSMA) that exhibit length change through magnetic field. Methods to produce the right texture have major applications in FSMA devices in actuator and sensors with extremely rapid mechanical response. One component of the research pertains to fabrication and characterization of unique smart Pb-free solders with shape memory alloy reinforcements for improved solder life. (*NSF, current. Also funded earlier through an ARO grant*).
- (iv) Characterization and analytical/computational modeling of powder metallurgy compaction processes and secondary processing (extrusion, rolling) as applied to nanograined Al alloys and composites. These materials have strengths that are in the 850 MPa to 900 MPa level (unheard values in

Al-alloys), and unique dual phase grain microstructure, consisting of nano-size grains and coarse micron sized grains. Approach involves elevated temperature mechanical testing to establish constitutive relations, and then using the data to conduct FEM analysis of extrusion and rolling. (**Army Research Laboratories**, multi-year contract, *current*)

(v) Prediction of ductility in Al-Si cast alloys, with microstructures influenced by casting conditions (primarily the secondary dendrite arm spacing): 2-D quantitative characterization, 3-D characterization utilizing serial sectioning and 3-D rendering, neutron diffraction and Raman measurements of phase stresses under *in situ* loading, and modeling. For the first time we showed that the in-plane stress components in the particle can be determined using Raman technique. (*NSF-CMS, completed Sept.2007*).

(vi) Development of high volume fraction (>0.10) carbon-nanotube (CNT) reinforced polymer composites, with application in high strength (>400 MPa), high toughness, and cryogenic applications. We currently focus on using FTIR of *in situ* loaded samples to understand loading of the polymer molecules next to the nanotubes, and combine that with *in situ* Raman measurements of the nanotube. This is also accompanied with understanding damage development using TEM. Enhanced delamination toughness of hybrid carbon-fiber composites has been obtained, and the mechanism has been ascribed to nanotubes bridging as confirmed by SEM observations. (**Navy**; collaborations with MER Corporation and Rice University, *current*)

(vii) Investigation into "twinning in nano-Aluminum". Recent papers in the journal Nature indicate that although pure Al has high stacking fault energy that oppose twinning, indeed twinning is observed in nano aluminum grains. However, there is controversy regarding the mechanism of twinning, and whether it can at all lead to macroscopic strains. We are investigating deformed pure-aluminum nanostructures with different but controlled microstructures, and are using both TEM technique and neutron diffraction based texture measurements and modeling in our analysis. (**Los Alamos National Laboratory** grant, *current*)

(viii) The understanding and modeling of local deformation under a sliding micro-indenter on Ni-single crystals. We studied orientation effects and the influence of slip on microstructure evolution (nano-size grains) and the resultant friction coefficient. Applications of this study are in LIGA MEMS systems. (*Sandia National Laboratories, just completed*)

(ix) Explosive processing of TaC nanopowders for pre-consolidation into sub-micron powders of high defect content, to allow low temperature (<1400 C) sintering and thereby prevent grain growth; the latter contributes to low fracture toughness in conventionally processed TaC (typically 1800C to 2400C). (*AFRL Edwards AFB, completed*).

(x) Metal-polymer interfaces, with an attempt to relate the chemistry and surface coverage of the polymer/metal-surface system to the toughness and strength of the interface. Recent work was aimed at understanding the relative roles of strain localization and interface chemistry, controlled by the number of bonding sites. (*Sandia National Laboratories, completed*).

xi) Development and characterization of a thermal barrier coating system for high temperature turbine blade application. (*AFRL, completed*)

(xii) Was the PI at NMT for Infrastructure Development in the area of Nanomaterials in New Mexico under NSF EPSCoR grant. In this capacity, Dr. Majumdar developed instrument resources at NMT (FESEM, EBSD, scanning Auger), developed collaborative connections with other NM Institutions (universities, national laboratories), and developed outreach courses on nanomaterials for middle school and high school teachers. (*NSF, completed 2005*)

## **EXPERIENCE**

Research and management as principal investigator (PI) and task leader (TL) of various research programs. Key government clients have been NSF, Air Force Laboratories, Army, Navy, NASA Lewis, NASA Marshall, NASA Ames, ORNL and DOE.

Sept'99-Present: Associate and currently full professor, Materials Department, New Mexico Tech  
July '92-Aug.'99: Senior Scientist at UES, Inc., Dayton, Ohio. Served as the principal investigator (PI) for UES in the focal area of metallic composites, as part of their research effort at the Materials Directorate, AFRL, Wright-Patterson Air Force Base, Ohio.  
'85-June'92 Principal Research Scientist, Battelle, 505 King Avenue, Columbus, Ohio 43201. Research on metals, ceramics, and composites.  
'83-84 Scientist E-1, Regional Research Laboratory, Bhopal, India. Research on MMCs.  
1982 Tenure track Assistant Professor, Mechanical Department, University of Rochester, NY-14627. Work stopped abruptly and unfortunately because of US visa problems.  
1981 Research Scientist, Systems Research Laboratory, Dayton, Ohio-45433. Research on superalloys and ceramics.

The research experience includes:

- Fracture mechanics of materials and interfaces: experiments and analytical/computational modeling.
- Metallic and Polymeric Composites: fiber and particulate reinforced composites, interface development, inelasticity and fracture mechanisms
- High strength nanostructured aluminum alloys
- Shape memory alloys and adaptive solders for flip-chip applications
- High temperature deformation of superalloys
- Carbon nanotube based composites
- Interface failure mechanisms and mechanics
- Structure property relations in titanium alloys and intermetallics
- Crack-tip shielding by dislocations
- Dislocations mechanisms in fatigue and fatigue crack growth
- Creep and creep crack growth with development of novel miniature specimens
- Material damage and life prediction
- Hydrogen-metal interactions in steels and titanium aluminides

## **PUBLICATIONS**

According to the *Sci-Search* database, Dr. Majumdar (use author index "majumdar bs") has over 700 citations. The largest citation has been on work related to *crack tip shielding* by dislocations, with significant impact on the understanding of brittle-versus-ductile behavior of materials. The second-most cited topic has been *metal matrix composites*.

### **(I) Refereed Publications (Journal Papers and Peer Reviewed Special Book Articles)**

*These published papers are organized by topic to provide insight on research areas:*

### Shape Memory Alloys

1. B. Ye, B.S. Majumdar and I. Dutta, Texture development and strain hysteresis in a NiTi shape memory alloy during thermal cycling under load, *Acta Materialia*, Vol.57, 2403-2417 (2009)
2. B. Ye, B.S. Majumdar and I. Dutta, Texture memory and strain texture mapping in a NiTi shape memory alloy, *Applied Physics Letters*, Vol.91, 061918, (2007)

### Superalloys

3. S. Ma, V. Seetharaman, and B.S. Majumdar, CRSS of  $\alpha/\alpha'$  phases from *in situ* neutron diffraction of a DS superalloy tension tested at 900°C, *Acta Materialia*, 56: 4102-4113 (2008)
4. Y. Lu, . Ma, and B.S. Majumdar, Elastic microstrains during tension and creep of superalloys: Results from *in situ* neutron diffraction, *Superalloy 2008*, Peer reviewed proceedings of the 4-yearly superalloy conference, Seven Springs, PA (Sept.14 -18, 2008)
5. S. Ma, D. Brown, M. A. M. Bourke, M. R. Daymond, and B. S. Majumdar, Microstrain evolution during creep of a high volume fraction superalloy, *Materials Sc. and Engg.*, Vol. A 399, pp.141-153, (2005)
6. S. Ma, P. Rangaswamy, and B.S. Majumdar, "Microstress Evolution During In-Situ Loading Of A Superalloy Containing High Volume Fraction of  $\alpha'$  Phase", *Scripta Materialia*, Vol. 48, No.5, pp.525-530 (2003)
7. S. Ma, B. Clausen, D. Brown, and B. S. Majumdar, "Internal Stress Evolution in a [001] Oriented Directionally Solidified Superalloy During Creep", Proceedings of TMS Fall Symposium on *Creep Deformation and Fracture, Design, and Life Extension*, (2005)

### Lead Free Solders

8. Z.X. Wang, I. Dutta, and B.S. Majumdar, Thermomechanical response of a lead-free solder reinforced with a shape memory alloy, *Scripta Materialia*, Vol.54 , pp. 627-632 (2006)
9. I. Dutta, B.S. Majumdar, D. Pan, W.S. Horton, W. Wright and Z.X. Wang, Development of Adaptive Lead-Free Solders Containing Reinforcements Displaying the Shape-Memory Effect, *J. Electronic Materials*, 33, No.4, pp.258-270 (2004)
10. Z.X. Wang, I. Dutta, and B.S. Majumdar, Thermal cycling response of a lead-free solder reinforced with adaptive shape memory alloy, *Materials Sc. and Engg. A*, Vol.421, pp.133-142 (2006); see also <http://infohost.nmt.edu/~majumdar/papers.html> (2006)
11. I. Dutta, D. Pan, S. Ma, B.S. Majumdar, and S. Harris, Role of shape memory alloy reinforcements on strain evolution in lead free solder joints, *J. Electronic Materials*, Vol.35, No. 10, 1902-1913 (2006); see <http://infohost.nmt.edu/~majumdar/papers.html> (2006)
12. I. Dutta, B.S. Majumdar, T. Chen, K.C. Chung, B. Ye, Smart lead free solder via shape memory alloy reinforcement, *MRS Proceedings* of MRS Fall Meeting 2006, Volume 968, Paper No. V06, Advanced Electronic Packaging, Eds. V.P. Atluri, S. Sharan, C.P. Wang and D. Frear (2007)
13. A. Kar, M. Ghosh, B.S. Majumdar, R.N. Ghosh, and A.K. Ray, Interfacial microstructure, shear strength and electrical conductivity of Sn-3.5Ag-0.5In/Cu lead free soldered joints, *Materials Technology*, Vol.22, No. 3 (2007)

14. A. Kar, M. Ghosh, R.N. Ghosh, B.S. Majumdar, and A.K. Ray, Evolution of mechanical and electrical properties of tin-lead and lead free solder to copper joint interface, *Materials Letters*, currently Online (2007)

#### **Cast Aluminum Alloys:**

15. S.J. Harris, A. O'Neil, W. Yang, P. Gustafson, J. Boileau, W. Weber, B.S. Majumdar, and S. Ghosh, Measurement of the state of stress in silicon with micro-Raman spectroscopy, *J. Applied Physics*, 96, No.12, pp.7195-7201 (2004)
16. S.J. Harris, A. O'Neil, J. Boileau, W. Donlon, X. Su and B.S. Majumdar, Application of Raman technique to measure stress states in individual Si particles in a cast Al-Si alloy, *Acta Materialia*, Vol.55, pp.1681-1693 (2007)

#### **Composites and Interfaces:**

17. A.B. Pandey, B.S. Majumdar, and D.B. Miracle, Laminated particulate reinforced aluminum composites with improved toughness", *Acta Metall.*, Vol. 49, pp.405-417 (2001)
18. C.J. Boehlert, B.S. Majumdar, and D.B. Miracle, Application of the cruciform specimen geometry to obtain transverse interface-property data in a high-fiber-volume-fraction SiC/titanium alloy composite", *Metallurgical Transactions*, Vol.32A, pp.3143-3155 (2001)
19. B.S. Majumdar and D. Hunston,"Continuous parallel fiber composites: Fracture", *Invited chapter in Encyclopedia of Materials: Science and Technology*, Eds. K.H. J. Buschow, R.W. Cahn, M.C. Flemings, B. Illschner, E.J. Kramer, and S. Mahajan, published (2001)
20. B.S. Majumdar, "Engineering mechanics, analysis and design with metal matrix composites", *invited chapter, ASM Handbook Vol.21 Composites*, pp.396-405 (2001)
21. B.S. Majumdar and A.B. Pandey, "Deformation and fracture of particulate reinforced aluminum alloy composites: Part II, Modeling", *Metallurgical Transactions*, Vol. 31A, pp.937-950 (2000)
22. A .B. Pandey, B.S. Majumdar, and D.B. Miracle, "Deformation and fracture of particulate reinforced aluminum alloy composites: Part I, Experiments", *Metallurgical Transactions*, Vol. 31A, pp.921-936 (2000)
23. Y. Ling, S. Ghosh, B.S. Majumdar, and R.Y. Kim, "Interfacial debonding in multi-fiber reinforced PMCs", *Mechanics of Materials*, Vol.32, pp.561-591 (2000)
24. B.S. Majumdar, W.D. Cowan, and N.J.Pagano, "Residual stresses in MEMS structures", *Thin Films: Stresses and Mechanical Properties VIII*, 1999 MRS Fall Proceeding, Vol. 594, Eds. R. Vinci, O. Kraft, N. Moody, P. Besser, and E. Shaffer II, p. 211(2000)
25. A.B. Pandey, B.S. Majumdar, and D.B. Miracle, "Effect of aluminum particles on the fracture toughness of a 7093/SiC/15p composite", *Materials Sc. and Engg.*, Vol.A259, pp.296-307 (1999)
26. B.S. Majumdar, "Development and characterization of new coatings for improved balance of mechanical properties of TMCs", *Materials Sc. and Engg.*, A259, pp.171-188 (1999)
27. G.P. Tandon, R.Y. Kim, S.G. Warriar, and B.S. Majumdar, "Influence of free edge and corner singularities on interfacial normal strength: application in model unidirectional composites", *Composites Part B*, 30, pp.115-134 (1999)

28. D.B. Miracle and B.S. Majumdar, "Transverse creep of SiC/Ti-6Al-4V fiber reinforced metal matrix composites", *Metall. Trans.*, Vol.30A, pp.301-306 (1999)
29. S.G. Warriar and B.S. Majumdar, "Elastic shielding during fatigue crack growth of titanium matrix composites", *Metall. Trans.*, Vol. 30A, pp.277-286 (1999)
30. S.G. Warriar, B. Maruyama, B.S. Majumdar, and D.B. Miracle, Behavior of several interfaces during fatigue crack growth in SiC/Ti-6Al-4V composites, *Materials Sc. And Engg., A*, Vol.259, No.2, pp.171-188 (1999)
31. B.S. Majumdar, T.E. Matikas, and D.B. Miracle, "Experiments and Analysis of Single and Multiple Fiber Fragmentation in SiC/Ti-6Al-4V MMCs", *Composites Part B*, Vol.29B, pp.131-145 (1998)
32. A.B. Pandey, B.S. Majumdar, and D.B. Miracle, "Effects of thickness and precracking on the fracture toughness of particle reinforced Al-alloy composites", *Metall. Trans. A*, Vol.29A, pp.1237-1243 (1998)
33. B.S. Majumdar, D. Gundel, R. Dutton, S.G. Warriar, and N.J. Pagano, "Evaluation of the tensile interface strength in brittle matrix composite systems", *J. Amer. Cer. Soc.*, Vol.81, No.6, pp.1600-1610 (1998)
34. B.S. Majumdar, Interfaces in Metal Matrix Composites, *Invited chapter* in book *Titanium Matrix Composites*, Ed. S. Mall and T. Nicholas, Technomic Publications, pp.113-168 (1997)
35. S.G. Warriar, B.S. Majumdar, and D.B. Miracle, "Interface effects on crack deflection and fiber bridging behavior during fatigue crack growth in titanium matrix composites", *Acta Metallurgica*, Vol.45, No.12, pp.4969-4980 (1997)
36. S.G. Warriar, B.S. Majumdar, and D.B. Miracle, "Determination of the interfacial failure mechanisms during transverse loading of single-fiber SiC/Ti-6Al-4V composites from torsion tests", *Acta Metallurgica*, Vol.45, No. 1, pp.309-320 (1997)
37. C.J. Boehlert, B.S. Majumdar, S. Krishnamurthy, and D.B. Miracle, "Role of matrix microstructure on RT tensile properties and fiber-strength utilization of an orthorhombic Ti-alloy based composite", *Metallurgical Transactions*, Vol.28A, pp.309-323 (1997)
38. S.G. Warriar and B.S. Majumdar, "Interface effects on fatigue crack growth of titanium matrix composites: modeling and impact on interface design", *Materials Sc. and Engg.*, Vol. A237, pp.256-267 (1997)
39. D.B. Gundel, B.S. Majumdar, S.G. Warriar, and M.L. Gambone, "A comprehensive approach to understanding the influence of the fiber/matrix interface on the properties of SiC fiber/Ti-alloy composites", *Key Engineering Materials*, Vol.127-(pt.1&2), pp. 631-638 (1997)
40. S.G. Warriar, B.S. Majumdar, D.B. Gundel and D.B. Miracle, "Implications of tangential shear induced failure during transverse loading of SiC/Ti-6Al-4V composites", *Acta Metall.*, Vol.45, No. 8, pp. 3469-3480 (1997)
41. B.S. Majumdar, S.G. Warriar and D.B. Miracle, "Interface effects on the tensile and fatigue crack growth behavior of fiber reinforced metal matrix composites", *Interfacial Engineering for Optimized Properties*, MRS proceedings, Ed. C.L. Briant, C. Barry Carter, and E.L. Hall, Vol. 458, pp. 185-190 (1997)

42. B.S. Majumdar and D.B. Miracle, "Interface measurements and applications in fiber-reinforced MMCs", *Key Engg. Materials*, Vol.116-117, pp.153-172 (1996)
43. S.G. Warriar, D.B. Gundel, B.S. Majumdar & D.B. Miracle,"Interface effects on transversely loaded single-fiber SCS-6/Ti-6Al-4V", *Metall. Trans.*,Vol. 27A, p. 2035 (1996)
44. A.B. Pandey, B.S. Majumdar and D.B. Miracle,"The fracture behavior of SiCp/Aluminum alloy composites with and without large Al-particles", Proceeding MRS Conference on Layered Materials, Ed. J.J. Lewandowski, pp.249-254 (1996)
45. S.G. Warriar, D.B. Gundel, B.S. Majumdar, and D.B. Miracle,"Stress distribution in a transversely loaded cross-shaped single fiber SCS-6/Ti-6Al-4V composite", *Scripta Metall.*, Vol.34, No.2, pp.293-299 (1996)
46. C.J. Boehlert, B.S. Majumdar, D. Eylon, and S.M. Russ,"Properties and damage mechanisms of three classes of titanium composite matrices", *Key Engg. Materials*, Vol. 127-131, pp.843-850 (1996)
47. I. Dutta and B.S. Majumdar,"Effect of processing on the fracture characteristics of a 6092 Al composite reinforced with SiCp", *Materials Science Forum*, Transtech Publications, Vol. 217-222, p. 1473-1478 (1996)
48. B.S. Majumdar and G.M. Newaz,"Constituent damage mechanisms in metal matrix composites under fatigue loading, and their effects on fatigue life", *Mat. Sc. and Engg.*, Vol. A200, pp. 114-129 (1995)
49. D.B. Gundel, B.S. Majumdar & D.B. Miracle,"Evaluation of the transverse response of fiber-reinforced composites using a cross-shaped sample geometry", *Scripta Metall.*, Vol.33, pp.2057-2065 (1995)
50. S.M. Pickard, D.B. Miracle, B.S. Majumdar, K. Kendig, L. Rothenflue, and D. Coker,"An experimental study of residual fiber strains in Ti-15-3 continuous fiber composites", *Acta Metall.*, Vol.43, No.8, pp. 3105-3112 (1995)
51. D.B. Gundel, B.S. Majumdar and D.B. Miracle,"The intrinsic transverse response of several SiC/Ti-6Al-4V composite subjected to transverse tension", Proceedings International Conference on Composite Materials, ICCM-10, Ed. A. Poursartip and K. Street, Vol. 2, Woodhead Publishing Limited, pp.703-710 (1995)
52. B.S. Majumdar and G.M. Newaz,, Damage mechanisms under in-phase TMF in a SCS-6/Ti-15-3 MMC", *HITEMP, NASA CP No. 10146*, pp.41.1-41.13 (1994)
53. B.S. Majumdar, G.M. Newaz, and J.R. Ellis,"Evolution of damage and plasticity in metal matrix composites", *Metall. Trans.*, Vol.24A, pp.1597-1610 (1993)
54. B.S. Majumdar and G.M. Newaz,"Inelastic deformation of MMCs: thermo-mechanical fatigue", *HITEMP, NASA CP No. 19117*, pp.36.1-16.12 (1993)
55. G.M. Newaz and B.S. Majumdar,"Failure modes in transverse MMC lamina under compression", *J. Mat. Sc. Letters*, Vol.12, pp. 551-552 (1993)
56. G.M. Newaz and B.S. Majumdar,"A comparison of the mechanical response of an MMC at room and elevated temperatures", *Composite Sc. and Technology*, Vol. 50, pp. 85-90 (1993)

57. B.S. Majumdar, G.M. Newaz, F.W. Brust, and J.R. Ellis, "Deformation mechanisms in a Ti-alloy/SiC metal matrix composite", *Titanium 92*, Ed. F.H. Froes and I. Caplan, pp. 2609-2616 (1993)
58. B.S. Majumdar and G.M. Newaz, "Inelastic deformation of metal matrix composites: plasticity and damage mechanisms", *Philosophical Mag.*, Vol.66, No. 2, pp.187-212 (1992)
59. G.M. Newaz, B.S. Majumdar, and F.W. Brust, "Crack initiation around holes in a unidirectional MMC under fatigue loading", *Engineering Fracture Mechanics*, Vol. 42, No. 4, pp. 699-711 (1992)
60. G.M. Newaz, B.S. Majumdar, and F.W. Brust, Thermal cycling response of quasi-isotropic metal matrix composites, Trans. Of ASME, *Journal of Engineering Materials and Technology*, Vol. 114, No.2, pp.156-161 (1992)
61. B.S. Majumdar and G.M. Newaz, "Thermo-mechanical fatigue of an angle-ply metal matrix composite", Composite Materials: Fatigue and Fracture, *ASTM STP 1110*, Ed. K. O'Brien, pp.732-752 (1991)
62. P.K. Rohatgi, S. Raman, B.S. Majumdar and A. Banerjee, "Ultrasonic techniques in evaluation of metal matrix particulate composites", *Mat. Sc. and Engg.*, Vol. A 123, pp.89-97 (1990)
63. B.S. Majumdar, A.H. Yegneswaran and P.K. Rohatgi, "Strength and fracture behavior of metal matrix particulate composites", *Mat. Sc. and Engg.*, Vol. 68, pp.85-96 (1984)

#### **Crack-Tip Shielding by Dislocations:**

64. B. S. Majumdar and S. J. Burns, "Crack tip dislocations in MgO", *Scripta Metall.*, Vol. 14, pp.653-656 (1980)
65. B. S. Majumdar and S. J. Burns, "Crack tip shielding - an elastic theory of dislocations and dislocation arrays near a sharp crack", *Acta Metall.*, Vol. 29, pp. 579-588 (1981)
66. B. S. Majumdar and S. J. Burns, "A griffith crack shielded by a dislocation pileup", *Int. J. of Fracture*, Vol. 21, p. 229 (1983)
67. A.R. Rosenfield and B.S. Majumdar, "Micromechanism and toughness for cleavage fracture of steel", *Nuclear Engg. Design*, Vol. 105, pp. 51-57 (1987)
68. A.R. Rosenfield and B.S. Majumdar, "A micromechanical model for cleavage crack reinitiation", *Metall. Trans.*, Vol. 18A, pp.1053-1059 (1987)

#### **Titanium Alloys**

69. C.J. Boehlert, B.S. Majumdar, V. Seetharaman, and D.B. Miracle, "The microstructural evolution in Ti-Al-Nb O+BCC orthorhombic alloys", *Metall. Trans.*, 30A, pp.2305-2323 (1999)
70. C.J. Boehlert, B.S. Majumdar, V. Seetharaman, D.B. Miracle, and R. Wheeler, "Phase evolution, stability, and microstructure-creep relations in an orthorhombic Ti-22Al-27Nb alloy", *Structural Intermetallics 1997*, Ed. M.V. Nathal, R. Darolia, C.T. Liu, D.B. Miracle, The Minerals, Metals and Materials Society, pp.795-804 (1997)
71. B.S. Majumdar, C.J. Boehlert, A.K. Rai, and D.B. Miracle, Structure Property Relations and Deformation Mechanisms in an Orthorhombic Based Ti-25Al-17 Nb Alloy, MRS Proceedings on

*High Temperature Ordered Intermetallics*, Ed. Horton et al. Materials Research Society, Pittsburgh, PA, vol. 364, pp. 1259-65 (1995)

### **Creep Crack Growth**

72. F.W. Brust and B.S. Majumdar, "Load history effects on creep-crack growth", *Engineering Fracture Mechanics*, Vol. 49, pp. 809-837 (1994)
73. F.W. Brust and B.S. Majumdar, Creep crack growth under history dependent loading, *Materials Science*, Vol. 30, No. 4, pp.431-438 (1994)
74. B.S. Majumdar, C.E. Jaske and M.P. Manahan, "Creep-crack growth characterization of Type 316 stainless steel using miniature specimens, *Int. J. Fract.*, Vol.47, pp.127-144 (1991)

### **Fatigue of LiF and MgO Crystals (Part of PhD research):**

75. B. S. Majumdar and S. J. Burns, "Push pull fatigue of LiF at elevated temperatures - Mechanical properties", *Acta Metall.*, Vol. 30, p. 1743 (1982).
76. B. S. Majumdar and S. J. Burns, "Push pull fatigue of LiF at elevated temperatures - Microstructures", *Acta Metall.*, Vol. 30, p. 1751 (1982)
77. B. S. Majumdar and S. J. Burns, "Fatigue hardening of LiF single crystals in push pull cyclic deformation", *Acta Metall.*, Vol. 29, pp. 425-436 (1981)
78. B.S. Majumdar and S.J. Burns, "TEM study of the recovery process of cyclically deformed MgO single crystals", *J. Materials Sc.*, Vol.22, pp. 1157-1162 (1987)

### **Fracture Mechanics and Mechanisms:**

79. A.R. Rosenfield, B.S. Majumdar, and P.K. Khandelwal, "Mixed-mode fracture toughness of silicon nitride at high temperatures using the diametrically compressed disk specimen", *J. Materials Sc.*, Vol. 30, pp.395-398 (1995)
80. A.R. Rosenfield and B.S. Majumdar, "Fracture toughness evaluation of ceramic bonds using a chevron-notch disk specimen", Chevron Notch Fracture Test Experience: Metals and Non-Metals, *ASTM STP 1172*, Ed. K.R. Brown and F.I. Baratta, pp.63-73 (1992)
81. J. Ahmad and B.S. Majumdar, "An engineering fracture mechanics analysis of metal/ceramic and ceramic/ceramic joints", *ASTM STP 1131*, Proc. 22nd. ASTM Nat. Symp. on Fracture Mechanics, Atlanta, Georgia, Eds. H. Ernst, A. Saxena, and T. McDowell, pp.590-614 (1992)
82. B.S. Majumdar, G.M. Newaz, and A.R. Rosenfield, "Yielding behavior of ceramic matrix composites", invited paper at the 7th. Int. Conf. on Fracture, *Advances in Fracture Research*, ICF-7, Ed. K.Salama et al., pp.2805-2814 (1989)

83. B.S. Majumdar, A.R. Rosenfield and W.H. Duckworth, "Crack resistance behavior of non-phase-transforming ceramics", *Engg. Fract. Mech.*, Vol.31, No.4, pp.683-701 (1988)

#### **Other Topics:**

84. S.L. Swartz, B.S. Majumdar, and A. Skidmore, "Joining of zirconia ceramics with a CaO-TiO<sub>2</sub>-SiO<sub>2</sub> interlayer", *Materials Sc. Letters*, Vol. 7, No.11, p. 407 (1989)
85. B.S. Majumdar, T. Mah, and M.G. Mendiratta, "Flaw growth in a polycrystalline lithium aluminum silicate glass ceramic", *J. Materials Sc.*, Vol. 17, p. 3129 (1982)

#### **First Paper Published by Majumdar**

86. R. Hariharan and B.S. Majumdar, "Moire displacement transducer for N/C systems", *IEEE Transactions on Instrumentation and Measurements*, Vol. IM-2F, pp.8-10 (1978)

#### **(III) Peer-Reviewed Proceedings/ Special Technical Publications**

(Arranged Chronologically)

87. L. Xu, D. Marchant, L. Matson, and B.S. Majumdar, Dynamic consolidation of TaC and nano-YSZ powders, *2006 Proceedings of SAMPE Conference, SAMPE 2006*
88. J. Robbins and B.S. Majumdar, Deformation mechanisms and toughening in carbon nanotube-reinforced polycarbonate matrix composites, in *Nano-composites, Their Science and Applications*, MS&T/TMS-06 Fall Meeting, Cincinnati, Ohio (Oct. 2006)
89. B.S. Majumdar, D. A. Lavan, Bing Ye and S.V. Prasad, Contact and adhesion of curved rough surfaces with application to MEMS, *Proc. World Tribology Congress, Paper No. WTC2005-63575*; ISBN: 0-7918-3767-X (Nov. 2005)
90. S.V. Prasad, J.R. Michael, C. Bataille, P.G. Kotula, and B.S. Majumdar, On the evolution of friction induced microstructure in single crystal nickel", *Proc. World Tribology Congress, Paper No. WTC2005-63577*; ISBN: 0-7918-3767-X (Nov. 2005)
91. M.S. Kent, H. Yim, D. Read, W. Yuen, E.D. Reedy, B. McAdams, R. Pearson, B.S. Majumdar, The relationship between interfacial interactions and crack initiation: effect of a singular stress field, *Proc. of the Adhesion Society Meeting*, Invited Paper (February 2005)
92. M.S. Kent, H. Yim, D. Read, W. Yuen, E.D. Reedy, B. McAdams, R. Pearson, B.S. Majumdar, The relationship between interfacial interactions and crack initiation: effect of a singular stress field, *Proc. of the Adhesion Society Meeting*, Invited Paper (February 2005)
93. M.S. Kent, H. Yim, J. Sorenson, A. Matheson, E.D. Reedy, B.S. Majumdar, B.J. McAdams, and R.A. Pearson, Using self assembled monolayers to explore the relationships between interfacial interactions and fracture in structural adhesive joints, *Proc. of the American Chemical Society*, Invited Paper (March. 2003)
94. M. S. Kent, H. Yim, J. Sorenson, A. Matheson, E. D. Reedy, and B.S. Majumdar, Using Self-Assembled Monolayers To Explore The Relationships Between Interfacial Interactions And

Fracture In Structural Adhesive Joints - 2, *Proc. of the World Congress on Adhesion and Related Phenomenon (WCARP)* (Feb. 2003)

95. S. Ma, P. Rangaswamy, D. Brown, and B.S. Majumdar, Microstresses and plasticity mechanisms in high-volume fraction superalloys, in *Modeling the Performance of Engineering Structural Materials*, Eds. T.S. Srivatsan, M. Leseur, and E. Taleff, TMS Publication, Warrendale, PA, pp. 357-370 (2002)
96. M.S. Kent, H. Yim, J. Sorenson, A. Matheson, E.D. Reedy, and B.S. Majumdar, "Using self assembled monolayers to explore the relationships between interfacial interactions and fracture in structural adhesive joints", *Proc. of the World Congress on Adhesion and Related Phenomenon (WCARP)*, (Feb. 2002)
97. H. Choo, B.S. Majumdar, P. Rangaswamy, and M.A.M. Bourke, Effect of reinforcement particle fracture on load partitioning in an Al-SiC Composite, *Proc. of Denver X-ray Conference*, also available in CD form (May 2002)
98. B.S. Majumdar, T.E. Matikas, and D.B. Miracle, Effects of the interface on local versus global load sharing behavior in metal matrix composites under longitudinal tension, *Proc. Int. Conf. On Composite materials, ICCM-11*, Sydney, Australia, CD-ROM (1997)
99. G.P. Tandon, S.G. Warrier, R.Y. Kim, and B.S. Majumdar, Edge effects on transverse loading of fiber reinforced composites, *Proceeding American Society of Composites, 12<sup>th</sup>. Meeting*, Technomic Publishing Co., Lancaster, PA, pp. 1176-1185 (1997)
100. B.S. Majumdar, Interface effects on fiber fragmentation and load sharing behavior of fiber-reinforced metal matrix composites, *Air Force Technical Report, No. WL-TR-97-4082*, d. P.R. Smith, pp. 54-65 (1997)
101. C.J. Boehlert, B.S. Majumdar, and D. Eylon, Properties and damage mechanisms of three classes of composite matrices, *CMMC 96, Proc. First International Conf. On Ceramic and Metal Matrix Composites*, v.127, pt.1 and 2, pp.843-850 (1997)
102. I. Dutta and B.S. Majumdar, Effect of processing on the fracture characterization of 6092 Al alloy composite reinforced with SiCp, *Aluminum Alloys, Their Physical and Mechanical Properties*, TMS publication, vol. 217, pp.1473-1478 (1996)
103. B.S. Majumdar & D.B. Miracle, "Fiber coatings for a sapphire/gamma-TiAl composite utilizing ductile and barrier metallic layers", *Proceedings International Conference on Composite Materials, ICCM-10*, Ed. A. Poursartip and K. Street, Vol. 2, Woodhead Publishing Limited, pp.747-754 (1995)
104. B.S. Majumdar and B.A. Lerch, Fatigue mechanisms in a Ti-based MMC and approaches to life prediction, *Proc. Air Force Workshop on Titanium Matrix Composites*, Ed. P.R. Smith and W. Revelos, *AF Tech Rep. No. WL-TR-93-4105*, pp. 409-426 (1993)
105. D.B. Miracle, B.S. Majumdar, S. Krishnamurthy, and M. Waterbury, The influence of matrix deformation on the tensile behavior in metal matrix composites, *Proc. ICCM-9*, Ed. A. Miravate, Vol.1, pp.610-624 (1993)
106. B.S. Majumdar, G.M. Newaz, and F.W. Brust, Constitutive behavior of metal matrix composites, *Proceedings of the ASME 1992 Winter Annual Meeting in Anaheim, California*, Ed. B.S. Majumdar, G.M. Newaz, and S. Mall, *MD-Vol.40*, pp.77-90 (1992)

107. C.J. Boehlert, B.S. Majumdar and D.B. Miracle, Effect of microstructure on the tensile, fatigue crack growth, and creep behavior of a Ti-25Al-25Nb orthorhombic alloy", *Fatigue and Fracture of Ordered Intermetallics: II*, Ed. W.O. Soboyejo. T.S. Srivatsan and R.O. Ritchie, The Mineral, Metals, and Materials Society, pp.135-153 (1995)
108. B.S. Majumdar and R. Rungta, Fatigue crack growth of corner cracks at notches for a beta STOA Ti-6Al-4V alloy, *Microstructure, Fracture, and Fatigue Crack Growth Rate in Titanium Alloys*, Ed. A. Chakrabarty, TMS, pp.111-130 (1987)
109. B.S. Majumdar and J. Ahmad, "Fracture of ceramic-metal joints: Zirconia/nodular cast iron systems, *Metal-Ceramic Joining*, Ed. P. Kumar and V. Greenhut, TMS Publication, pp.67-78 (1991)
110. B.S. Majumdar, H.J. Cialone, and J.H. Holbrook, Solubility of high pressure hydrogen in TiAl, Ti<sub>3</sub>Al, and Be, and effects on microstructures, 3<sup>rd</sup>. *NASP Workshop on Hydrogen Metals Compatibility* at Scottsdale, Arizona, p.201 (1989)
111. B.S. Majumdar, H.J. Cialone, and J.H. Holbrook, Hydrogen compatibility of gamma TiAl, *NASP Workshop Publication No. 1013*, pp.97-136 (1993)
112. R. Rungta and B.S. Majumdar, Materials behavior related issues for bolting applications in the nuclear industry, *Improved Technology for Critical Bolting Applications, ASME, MPC – Vol26*, Ed. E.A. Merrick and M. Prager, p. 39 (1986)
113. B.N. Keshavram, K.G. Satyanarayana, P.K. Rohatgi, B.S. Majumdar, and B. Dattaguru, Fracture and strength behavior of Al-glass and Al-flyash composites, *Advances in Fracture Research*, ICF-6, Ed. Valluri et al., Vol.4, p.2979 (1984)
114. M. Stucke, M. Khobaib, B.S. Majumdar, and T. Nicholas, Environmental aspects of creep crack growth in a nickel base superalloy, *Advances in Fracture Research*, Ed. Valluri et al., p. 1159 (1984)

### **BOOKS:**

None, except as editor of conference proceedings, invited chapter of books, and special issues of journals (see below)

*Editor* of Special Issue of *Materials Science and Engineering A* on *Internal Stresses in Materials*. (Elsevier) (2006)

*Editor* of special issue of *Metallurgical Transactions* on *Composite Materials* (2000)

*Editor* of ASME conference proceedings entitled, "*Constitutive Behavior of High Temperature Composites*", ASME, MD-Vol. 40 (1992)

*Editor* of special issue of the *Materials Sc. and Engineering A*, *Mechanisms and Mechanics of MMC Fatigue*, Vol. 200A (1995)

B.S. Majumdar and D. Hunston, "Continuous parallel fiber composites: Fracture", *invited chapter in Encyclopedia of Materials: Science and Technology*, Eds. K.H. J. Buschow, R.W. Cahn, M.C. Flemings, B. Illschner, E.J. Kramer, and S. Mahajan, published (2001)

B.S. Majumdar, "Engineering mechanics, analysis and design with metal matrix composites", *invited chapter in ASM Handbook Vol.21 Composites*, pp.396-405 (2001)

B.S. Majumdar, Interfaces in Metal Matrix Composites, *invited chapter in book Titanium Matrix Composites*, Ed. S. Mall and T. Nicholas, Technomic Publications, pp.113-168 (1997)

## **TECHNICAL REPORTS**

- B.S. Majumdar and G.M. Newaz, *Isothermal Fatigue Mechanisms in Ti-Based Metal Matrix Composites*, NASA Report No. NASA-CR-191181 (1993)
- G.M. Newaz and B.S. Majumdar, *Inelastic Deformation Mechanisms in SCS-6/Ti-15-3 Lamina Under Compression*, NASA Report No. NASA-CR-191170 (1993)
- B.S. Majumdar and G.M. Newaz, *Inelastic Deformation of Metal Matrix Composites – Part I, Plasticity and Damage*, NASA Report No. NASA-CR-189095 (1992)
- B.S. Majumdar and G.M. Newaz, *Inelastic Deformation of Metal Matrix Composites – Part II, Plasticity and Damage at High Temperatures*, NASA Report No. NASA-CR-189096 (1992)
- B.S. Majumdar, H.J. Cialone, and J.H. Holbrook, *Bulk Absorption and Microstructural Effects of High Pressure Elevated Temperature Hydrogen on Gamma TiAl, Alpha-2 Ti3Al, and Beryllium*, NASP Report No. 1120, NASA Ames (August 1991)
- J.A. Ahmad, B.S. Majumdar, and A.T. Hopper, *Development And Validation Of A Model For Assessment And Design Of Ceramic-Ceramic And Ceramic-Metal Joints*, Proceedings of the 1990 Annual Automotive Technology Contractors Meeting, P-243, p. 283 (1991)
- N. Ashbaugh, H. Bernstein, B.S. Majumdar and J.A. Ahmad, *Mechanical Property Characterization and Modeling of Structural Materials*, Air Force technical Report, AFWAL-TR-81-4187 (1981)
- R. Rungta and B.S. Majumdar, *Stress Corrosion Cracking of Alternate Bolting Alloys*, EPRI Report No. 2058-12 (1986)
- B.S. Majumdar, *The Analysis of Oxygen Diffusion Ahead of a Running Crack*, Internal Report, Wright Patterson AFB, (1981)
- B.S. Majumdar, *Structure and Properties of Iron Aluminides: A Review*, Report submitted to the Wright Patterson AFB (1990)
- B.S. Majumdar and C.E. Jaske, *Structure and Properties of 21/4 Cr – 1 Mo Steel*, Metals and ceramic Information center, Structural Alloys Handbook, (1990)
- B.S. Majumdar, *Push-Pull Fatigue of LiF and MgO Single Crystals*, Ph.D. Dissertation, University of Rochester, under the direction of Prof. Stephen J. Burns (1980)

Other final reports to industrial clients: (i) elevated temperature fracture toughness evaluation of steel samples removed from heat affected zones of steam pipes, (ii) hydrogen stress cracking of pre-stressing steel wires, (iii) fabrication and characterization of titanium diboride, (iv) hydrogen cracking of steel components in paper machinery, etc. Those reports belong to clients.

## **PRESENTATIONS:**

(Some Recent Presentations)

- B. Ye, L. Yang, *B.S. Majumdar*, and I. Dutta, Smart reinforcement mechanisms in composite solders, *Invited Presentation, TMS Fall Meeting, MS&T 07, Detroit, (September 18, 2007)*
- S.J. Harris, J. Boileau, and *B.S. Majumdar*, Application of the Raman technique to measure stress states in individual Si particles in a cast Al-Si alloy, *TMS Spring Meeting, Orlando, Florida (February 28, 2007)*
- Y. Lu, V. Seetharaman, and *B.S. Majumdar*, High temperature deformation behavior of nanostructured materials: case of superalloys with high volume fraction of gamma-prime phase, *TMS Fall Meeting, MS&T06, Pittsburgh, (October 17, 2006)*
- L. Yang, I. Dutta, and *B.S. Majumdar*, Thermomechanical response of a lead-free solder reinforced with a shape memory alloy, *TMS Annual Meeting, San Antonio (March 2006)*
- *B.S. Majumdar* and Bing Ye, Plasticity of single crystals under a sliding indenter, *Invited Presentation on the occasion of J.C.M. Li's 80th. Birthday, TMS Annual Meeting, San Francisco (February 13-17, 2005)*
- *B.S. Majumdar*, S. Ma, D. Brown, Measurement and modeling of internal stresses in directionally solidified high volume fraction superalloys at high temperatures, *Invited Presentation, TMS Annual Meeting, San Francisco (February 13-17, 2005)*
- M.Erukullu, B. Ye, S. Harris, S. Ghosh, and *B.S. Majumdar*, Measurement and modeling of internal stress and damage in Al-Si alloys, *TMS Fall Meeting, Pittsburgh, (November 2005)*
- Y. Lu, S. Ma, D. Brown, B. Clausen, V. Seetharaman, and *B.S. Majumdar*, Deformation behavior of DS and SX superalloys as revealed by neutron diffraction measurements, *MECASSENS 2005, all invited presentations, Santa Fe (October 2005)*
- S.J. Harris, P. Gustafson, J. Boileau, A. O'Neil, *B.S. Majumdar*, and S. Ghosh, "Measurement of the stress states in eutectic silicon particles in cast aluminum", *Internal Stress Symposium at the TMS Spring Meeting in Charlotte, NC (March 2004)*
- Z.X. Wang, I. Dutta, and *B.S. Majumdar*, "Double shear thermomechanical fatigue response of a lead-free solder reinforced with SMA fiber", *TMS Spring Meeting in Charlotte, NC (March 2004)*
- S. Ma, P. Rangaswamy, D. Brown, and *B.S. Majumdar*, "Measurement and modeling of internal stresses during creep of a polycrystalline superalloy", *TMS Spring Meeting in Charlotte, NC (March 2004)*
- Z.X. Wang, I. Dutta, and *B.S. Majumdar*, "Thermomechanical fatigue response of an adaptive lead free solder", *TMS Fall Meeting in New Orleans (October 2004)*

- M.S. Kent, H. Yim, J. Sorenson, A. Matheson, E.D. Reedy, B.S. Majumdar, B.J. McAdams, and R.A. Pearson, "Using self assembled monolayers to explore the relationships between interfacial interactions and fracture in structural adhesive joints", American Chemical Society, Invited Paper (March. 2004)
- S. Ma, D. Brown, and B.S. Majumdar, "Internal stress evolution and deformation mechanisms in a superalloy containing a high volume fraction of  $\gamma'$  phase", Invited presentation at the TMS Fall 2003 meeting in Chicago (Nov. 2003)
- B.S. Majumdar and M.S. Kent, "Using self-assembled monolayers to probe fundamental issues of bonding at polymer/glass interfaces", Invited presentation at the two-yearly invited-only conference entitled: Composites at Lake Louise, Lake Louise, Canada (Oct. 2004)
- S. Ma, P. Rangaswamy, D. Brown, T. Sisneros, and B.S. Majumdar, "Internal stresses and dislocation structure development in a superalloy containing a high volume fraction of  $\gamma'$  phase", Invited presentation at the LUG User meeting in Los Alamos (Oct. 2003)
- S. Ma, D. Brown, B. Clausen, M.A.M. Bourke, and B.S. Majumdar, "Microstrain evolution during creep of a polycrystalline superalloy", TMS Annual Meeting in San Diego (March 2003)
- I. Dutta, B.S. Majumdar, S. Choi, and W. Wright, "A strategy for producing adaptive lead-free solder joints via shape memory alloy reinforcement of solder alloys", Invited presentation at the TMS Annual Meeting in San Diego (Feb. 2003)
- S. Ma, P. Rangaswamy, D. Brown, and B.S. Majumdar, "Microstresses And Plasticity Mechanisms In High-Volume Fraction Superalloys", in Modeling the Performance of Engineering Structural Materials", presented at the Fall TMS meeting in Columbus, Ohio (Oct. 2002)
- B.S. Majumdar, "Fracture and damage in particle reinforced metal matrix composites", presented at the Fall TMS special symposium on Fracture in honor of professor John Knott, Columbus, Ohio (Oct. 2002)
- The following poster won the best graduate paper at the Annual RioGrande Conference: S. Ma, P. Rangaswamy, and B.S. Majumdar, "Microstress Evolution in a Polycrystalline Superalloy Containing a High Volume fraction of  $\gamma'$  Phase", Albuquerque (Oct. 2002)
- S. Ma, D. Brown, B. Clausen, M. Bourke, and B.S. Majumdar, "Microstrain Evolution During Creep Of A Polycrystalline Superalloy", accepted for presentation at the 2003 Spring TMS Meeting, San Diego, Mar 2-6, (2003)
- B.S. Majumdar, P. Rangaswamy, H. Choo, and M.A.M. Bourke, "Microstress evolution and probing of damage in particle reinforced Al-alloy composites using neutron diffraction and modeling", *invited presentation* at the 2001 TMS/ASM Fall meeting in Indianapolis, Nov. 2001
- B.S. Majumdar, "Fracture toughness modeling and R-curve behavior of particle reinforced MMCs", *invited presentation* at the 2001 TMS/ASM Fall meeting in Indianapolis, Nov. 2001
- B.S. Majumdar, "Damage study in particle reinforced composite systems using neutron diffraction", LANSCE Users Workshop, Los Alamos National Laboratory, August 2001
- B.S. Majumdar, "Issues in fracture toughness and R-curve behavior of particle reinforced metal matrix composites", presented by a peer researcher at the International Conf. On Fracture (ICF10), Honolulu, Dec. 2001

## SERVICES

### Professional Membership

- TMS (Member of Composites Committee, Mechanical Behavior Committee)
- American Society for Metals (ASM)

1. Reviewer for: Reviewer for *Metallurgical Transactions*, *Acta Materialia*, *Scripta Materialia*, *Materials Science and Engineering*, *NSF proposals* from DMR and CMMI, *AFOSR proposals*, *Materials Technology*, *Journal of Materials Science*, *Composites B*, *J. of Composite Materials*

In addition, I continue to actively participate in the Composites Committee and the Mechanical Behavior Committee at TMS. As part of the former, we are developing a database for products, manufacturers, users, etc. of MMC, that will soon be available through the TMS web-site.

### 2. Meetings:

*Co-Organizer* of TMS 2009 Symposium entitled Nanocomposites, a seven-session symposium to be held at San Francisco during the 2009 TMS annual meeting (February 2008)

*Principal Organizer* of TMS 2008 Symposium entitled, "Mechanics and Kinetics of Interfaces in Multicomponent Material Systems", a five-session symposium held in New Orleans (March 2008)

*Principal organizer* of the *Symposium on Fracture of Composite Materials* , held as part of the TMS Fall Meeting, Pittsburgh, September (2005)

*Principal organizer* of the Symposium on Internal Stresses in Materials, held as part of the TMS Annual Meeting, March 15 (2004) in Charlotte, NC. This included my role as a guest editor of a special issue of the *Materials Science and Engineering A* journal.

*Editor* of special issue of *Metallurgical Transactions* on Composite Materials, based on a TMS symposium organized by me (2000)

3. Collaborative Research in New Mexico: As part of New Mexico Tech in the focal area of nanomaterials under the NSF funded EPSCoR program, I have attempted to develop collaborative activities between the various state supported universities in NM. This has included planning meetings with counterpart researchers at UNM and NMSU on current and future research, as well as infrastructure needs. We have also interacted with the state colleges and K-12 schools, with the aim of developing

curriculum and lesson plans that make students more familiar with the new world of nanoscience and nanotechnology. Because of our interactions, we now have much better interactions with other NM faculty, and use of their special instrument facilities.

### **LABORATORY SERVICES**

Mechanical testing: Includes standard tensile, compression, hardness, and fatigue testing. The latter includes both strain controlled low-cycle and stress controlled high cycle fatigue. In addition, we conduct fracture toughness and fatigue crack growth testing using different specimen geometry. Crack length measurements are inferred from both crack opening displacement, optical, and electric potential techniques. Test machines include a state-of-the-art 25 kN MTS 858 servohydraulic test frame, a 100 kN MTS servohydraulic frame, furnace for high temperature tension and creep tests (up to 1000 C), thermal cycling apparatus for -20C to 120 C (solder reliability application) and for high temperature cycling (thermal barrier coating application). Other equipment and softwares in my laboratory include optical microscopes, plasma etcher, high power sonicator, special high power mixer, heaters and furnaces, Iotech state-of-the-art data acquisition system featuring DaisyLab, Abaqus CAE/Explicit software, GSAS Rietveld refinement software to analyze XRD and neutron diffraction data, advanced image analysis software for 3-D rendering of serial sections. We also work closely with the EBSD orientation imaging system that is part of the FESEM in our department, and we routinely utilize the TEM at NMT and the HRTEM at the University of New Mexico.

### **AWARDS**

Recipient of the Outstanding Researcher Award for 2008 at New Mexico Tech, conferred May 2008.