CURRICULUM VITAE OF A.F. BOWER, December 2019

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EDUCATION

A. Undergraduate degree: B.A.(1st Class), Cambridge University, UK, 1984
B. Higher degrees: M.A., University of Cambridge, UK, 1988
Ph.D., University of Cambridge, UK, 1988

PROFESSIONAL APPOINTMENTS

1987 – 1989 Visiting Research Associate, Division of Engineering, Brown University
1989 -- 1991 University Assistant Lecturer, Department of Engineering, University of Cambridge, UK.
1991 -- 1997 Assistant Professor of Engineering, Brown University
1997 – 2003 Associate Professor of Engineering, Brown University

COMPLETED PUBLICATIONS

Books

- Applied Mechanics of Solids. CRC Press, 794pp, 2009 (http://solidmechanics.org)

Refereed Journal Articles

1. "The residual stress distribution in a plastically deforming asperity," (With A.V. Olver, H.A. Spikes and K.L. Johnson), *Wear*, **107**, pp.151--174, (1986).
2. ``The influence of crack face friction and trapped fluid on surface initiated rolling contact fatigue cracks," *Journal of Tribology* , **110**, pp.704--711, (1988). Award for best paper presented at technical sessions of ASME Tribology Division during 1988.
3. "Cyclic hardening properties of hard--drawn copper and rail steel," *Journal of the Mechanics and Physics of Solids*, **37**(4), pp.455--470, (1989).
4. "The influence of strain hardening on cumulative plastic deformation in rolling and sliding contact,"' with K.L. Johnson, *Journal of the Mechanics and Physics of Solids*, **37**(4), pp.471--493, (1989).
5. "Solution of three--dimensional crack problems by a finite perturbation method,"" (with M. Ortiz). *Journal of the Mechanics and Physics of Solids*, **38**(4), pp.443--480, (1990).
6. "Plastic flow and shakedown of the rail surface in repeated wheel--rail contact," (With K.L. Johnson), *Wear* , **144** , pp. 1--18, (1991).
7. "A three dimensional analysis of crack trapping and bridging by tough particles," (With M. Ortiz), *Journal of the Mechanics and Physics of Solids*, **39** , (6), pp.815--858, (1991)
8. "Indentation of a power law creeping solid," (With N.A. Fleck, A. Needleman, and N. Ogbonna), *Proceedings of the Royal Society of London , Ser. A*, **441** , p.97--124, (1993).
9. "An Analysis of crack trapping by residual stresses," (With M. Ortiz), *Journal of Applied Mechanics* , 60 (1), p.175, (1993).
10. "The influence of grain size on the toughness of monolithic ceramics," (with M. Ortiz), A.S.M.E. *Journal of Engineering Materials and Technology* , **115** (3), 228, (1993).

11. "Analysis of stress induced void growth mechanisms in passivated interconnect lines," (With L.B. Freund), *Journal of Applied Physics*, **74** , (6), 3855--3867, (1993).
12. "An analysis of non--planar crack growth under mixed--mode loading," (With G. Xu and M. Ortiz), *International Journal of Solids and Structures* , **31** , (16), 2167--2193, (1994).
13. "Brittle fracture under a sliding line contact," (with N.A. Fleck), *Journal of the Mechanics and Physics of Solids* , **42** , (9), 1375--1396, (1994).
14. "An analysis of fracture and delamination in thin coatings subjected to contact loading," (With Sonia Oliveira), *Wear* , **198** , 15--32, (1996).
15. "A finite element analysis of the motion and evolution of voids due to strain and electromigration induced surface diffusion," (with L. Xia, Z. Suo and C.F. Shih), *Journal of the Mechanics and Physics of Solids* , **45** (9), 1473-1493, (1997).
16. "Modelling failure mechanisms in the interconnect lines of microelectronic circuits," (with D. Craft), *Fatigue and Fracture of Engineering Materials and Structures* , **21** , pp.611-630, (1998).
17. "The influence of crack trapping on the toughness of fiber reinforced composites," (with G. Xu and M. Ortiz), *Journal of the Mechanics and Physics of Solids*, **46** , (10), p. 1815, (1998).
18. "Three dimensional finite element analysis of the evolution of voids and thin films by strain and electromigration induced surface diffusion," (with Y.W. Zhang, L. Xia and C.F. Shih), *Journal of the Mechanics and Physics of Solids*, **47** , (1), p.173 (1999).
19. "The influence of anisotropic surface diffusivity on electromigration induced void migration and evolution," (With D. Fridline), *Journal of Applied Physic*s, **85** , (6), pp.3168--3174, (1999)
20. "Three Dimensional simulations of island formation in a coherent strained epitaxial film," (with Y.W. Zhang), *Thin Solid Films,* **357** (1) 8, (1999).
21. "Numerical simulations of island formation in a coherent strained epitaxial thin film system," (with Y.W. Zhang), *Journal of the Mechanics and Physics of Solids* , **47** (11), 2273, (1999).
22. "A diffuse interface model for electromigration and stress voiding," (with D.N. Bhate and A. Kumar), *Journal of Applied Physics*, **87** (4), 1712-1721, (2000).
23. "Three dimensional analysis of shape transitions in strained heteroepitaxial islands," (with Y.W. Zhang) *Applied Physics Letters*, **78** (18) 2706-2708 (2001).
24. "Numerical simulations of stress induced void evolution and growth in interconnects," (with D. Fridline) *Journal of Applied Physics*, **91** 2380 (2002)
25. "Phase field model for failure in interconnect lines due to coupled diffusion mechanisms," (with D.N. Bhate and A. Kumar) *Journal of the Mechanics and Physics of Solids*, **50** , 2057-2083, (2002)
26. "Intrinsic tensile stress and grain boundary formatino during Volmer-Weber film growth," (with A. Rajamani, B.W. Sheldon, E. Chason) *Applied Physics Letters* , **81** (7), 1204--1206, (2002).
27. "Simulated self-assembly and optoelectronic properties of InAs/GaAs quantum dot arrays," (with H.T. Johnson and V. Nguyen) *Journal of Applied Physics*, **92** , 4653, (2002)
28. "The central role of excluded volume in the production of stress in anisotropic polymer melts," (with J.H. Weiner), *Journal of Chemical Physics* , **118** (24), 11297 (2003)
29. "Morphological evolution driven by strain induced surface diffusion," (with Y. Zhang and P. Liu), *Thin Solid Film* , **424** (1), 9, (2003)
30. "A two-dimensional finite element method for simulating the constitutive response and microstructure of polycrystals during high-temperature plastic deformation," (with E. Wininger), *Journal of the Mechanics and Physics of Solids*, **52** 1289-1317 (2004)
31. "Numerical simulations of the growth and deflection of a stress-corrosion crack on the interface between two brittle solids," (with Z. Tang and T.J. Chuang), *Int. J. Fracture*, **127** , (1), pp. 1-20 (2004)
32. "The role of pressure in rubber elasticity," (With J.H. Weiner) *J. Chem. Phys*, **120** (24) pp. 11948-11964 (2004)
33. "A simple technique for avoiding convergence problems in finite element simulations of crack nucleation and growth on cohesive interfaces," (With Y.F. Gao) *Modelling Simul. Mater. Sci. Eng.* , **12** , 453-463 (2004)
34. "Numerical simulations and experimental measurements of stress relaxation by interface diffusion in a patterned copper interconnect structure," (with N. Singh, D. Gao, P.S. Ho, S. Shankar and J. Leu), *J. Appl. Phys*. **97**, 013539 (2005)
35. "Elastic-plastic contact of a rough surface with Weierstrass profile," (With Y.F. Gao) *Proc Roy Soc Lond A* **462** (2065): 319-348 (2006)

36. "The behavior of an elastic-perfectly plastic sinusoidal surface under contact loading," (with Y.F. Gao, K.S. Kim, L. Lev and Y.T. Cheng), *Wear*, **261** (2) 145-154, (2006)
37. "The role of monomer packing fraction in rubber elasticity," (With J.H. Weiner) *J. Chem. Phys*, **125** (9) pp. 096101-2 (2006)
38. "Experimental validation of a two-dimensional finite element method for simulating constitutive response of polycrystals during high temperature deformation," (with S. Agarwal, P.E. Krajewski, C.L. Briant and E. Taleff) *Journal of Materials Engineering and Performance,* **16** (2) pp.170--178, (2007)
39. "Surface versus bulk nucleation of dislocations during contact of rough surfaces," (with L. Nicola, A. Needleman, K.S. Kim and E. van der Giessen) *Journal of the Mechanics and Physics of Solids*, **55** (6), pp.1120--1144, (2007)
40. "Unwinding of a strained cholesteric elastomer by disclination loop nucleation," (with A. Callan-Jones, R. Pelcovits and R.B. Meyer) *Physical Review E* **75** (1) 011701 (2007)
41. "Delamination mechanism maps for a strong elastic coating on an elastic-plastic substrate subjected to contact loading," with S. Xia, Y.F. Gao, K.S. Kim, L. Lev and Y.T. Cheng," *Int J. Solids Structures*, **44** , pp.3685-3699, (2007)
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43. "A kinetic model of stress evolution during coalescence and growth of polycrystalline thin-films," (with J.S. Tello, E. Chason and B.W. Sheldon), *Physical Review Letters*, **98** (21) 216104 (2007)
44. "Steady-state tensile stresses during the growth of polycrystalline films", (with B. W. Sheldon, A. Bhandari, S. Raghavan, X. J. Weng and M. Redwing), *Acta Materialia*, **55** , pp. 4973-4982, (2007).
45. "Numerical simulations of void nucleation, growth and evolution in interconnects," with S. Shankar, *Modeling and Simulation in Materials Science and Engineering*, **15** pp. 923-940 (2007). Also published in IOP Select (papers selected by editors of IOP Journals on the basis of "Substantial advances or significant breakthroughs, a high degree of novelty, or significant impact on future research")
46. "Determination of the effective mode-I toughness of a sinusoidal interface between two elastic solids," with P. Zavattieri and L. Hector, *International Journal of Fracture*, **145** (3) (2007), see also 146 (3), 167--180, (2007)
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51. "Plastic Deformation Processes in Cu/Sn Bimetallic Films Related to Whisker Formation," (with S. Kumar. L. Rheinbold and E. Chason), *Journal of Materials Research*, **23** , (11), 2916--2934, (2008)
52. "Recoverable creep deformation and transient local stress concentration due to heterogeneous grain-boundary diffusion and sliding in polycrystalline solids," (with Yujie Wei and Huajian Gao), *Journal of the Mechanics and Physics of Solids,* **56** , (4), 1460--1483, (2008)
53. "Multi-asperity contact: a comparison between discrete dislocation and crystal plasticity predictions," (with L. Nicola, K-S. Kim, A. Needleman and E. Van der Giessen), *Philosophical Magazine*, **88** (30-32) pp.3713-3729, (2008)
54. "The influence of heterogeneity in grain boundary sliding resistance on the constitutive behavior of AA5083 during high-temperature deformation," (with David Cipoletti, Yue Qi and Paul E. Krajewski), *Materials Science and Engineering A*, **504,** (1-2) 175-182, (2009)
55. "Numerical simulations of necking during tensile deformation of aluminum single crystals," (with Fan Zhang, Raj Mishra and Kevin Boyle), *International Journal of Plasticity*, **25** (1), 49--69 (2009).
56. "Numerical simulations of crack deflection at a twist misoriented grain boundary between two ideally brittle crystals," (with Y. Wei and H. Gao), *Journal of the Mechanics and Physics of Solids,* **57** (11), pp.1865-1879, (2009)
57. "A model of Sn whisker growth by coupled plastic flow and grain boundary diffusion," (With E. Buchovecky and N. Du), *Applied Physics Letters*, **94**(19), 191904, (2009)

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61. “Understanding the correlation between intermetallic growth, stress evolution and Sn whisker nucleation,” (with N. Jadhav, E. Buchovecky, L. Reinbold, S. Kumar, and E. Chason) IEEE transactions on Electronics Packaging and Manufacturing **33**, (3), 183-192. (2010)
62. “Aluminum grain boundary sliding enhanced by vacancy diffusion,” (with N. Du, Y. Qi, and P.E. Krajewski), Acta Materialia, Volume 58, Issue 12, July 2010, Pages 4245-4252
63. “Analytical model and molecular dynamics simulations of the size dependence of flow stress in amorphous intermetallic nanowires at temperatures near the glass transition,” (with Y. Wei and H. Gao), Physical Review B, Vol. 81(12), Art. No. 125402 (2010)
64. “A three dimensional model of electromigration and stress induced void nucleation in interconnect structures,” (with N. Singh and S. Shankar) , Modelling and Simulation in Materials Science and Engineering **18** 065006 (2010)
65. “New approach to gas pressure profile prediction for AA5083 sheet forming” (with F. Jaffar, L. G. Hector, Jr. and M. Khraisheh), Journal of Materials Processing Technology, Volume 210, Issues 6-7, 1 April 2010, Pages 825-834
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68. “The Effect of Solute Atoms on Aluminum Grain Boundary Sliding at Elevated Temperature,” (with Yue Qi, Ningning Du, Paul Krajewski) Metallurgical and Materials Transactions, **42A**, 651-659, (2011)
69. “Finite element implementation of a kinetic model of dynamic strain ageing in Aluminum-Magnesium Alloys.” (with F. Zhang and W.A. Curtin), International Journal of Numerical Methods in Engineering **86**, 90-92, (2011).
70. “A Finite Strain Model of Stress, Diffusion, Plastic. Flow and Electrochemical Reactions in a Lithium-ion Half-Cell,” (With V. Sethuraman and P.R. Gruduru) Journal of the Mechanics and Physics of Solids, **59**, 804-828, (2011)
71. “A microstructure based model of the deformation mechanisms and flow stress during elevated temperature straining of magnesium alloys,” (With D. Cipoletti and P.E. Krajewski) Scripta Materialia **64**, 931-934 (2011)
72. “Atoms to Autos: A Multi-scale approach to modeling Aluminum Deformation,” (With P.E. Krajewski, L.G. Hector, Y Qi, R.K. Mishra, A.K. Sachdev and W.A. Curtin), Journal of Materials **63** (11), 24-32, (2011)
73. “The influence of serrated flow on necking in tensile specimens,” (with F. Zhang and W.A. Curtin), Acta Materialia **60** (1) 43-50, (2012)
74. “Real-Time Stress Measurements in Composite Lithium-ion Battery Anodes during Electrolyte Wetting and Electrochemical Cycling,” (with V.A. Sethuraman, N. Van Winkle, D.P. Abraham and P. Guduru), Journal of Power Sources 206, 334-342 (2012)
75. “A simple finite element model of diffusion, finite deformation, plasticity and fracture in lithium ion insertion electrode materials,” (with P.R. Guduru), Modeling and Simulation in Materials Science and Engineering, **20** 045004, (2012)
76. “Toughness of a patterned interface between two elastically dissimilar solids,” (with F. Cordisco, P. Zavattieri and L.G. Hector, Jr), Engineering Fracture Mechanics, in press (2012)
77. “Diffusion mediated lithiation stresses in Si thin film electrodes,” (with S. Soni, B. Sheldon, X. Xiao, M. Verbrugge) Journal of The Electrochemical Society 159 (9), A1520-A1527 (2012)
78. “Growth of whiskers from Sn surfaces: driving forces and growth mechanisms,” (with Eric Chason, Nitin Jadhav and Eric Buchovecky) Progress in Surface Science, **88**, 103-131, (2013)

79. “Microscale calibrated modeling of the deformation response of low-carbon martensite,” (with Hassan Ghassemi-Armaki, Peng Chen, Shrikant Bhat, Sriram Sadagopan, and Sharvan Kumar), Acta Materialia, **61** (10) 3535-3904 (2013).
80. "Anisotropy in plastic deformation of extruded magnesium alloy sheets during tensile straining at high temperature," (with D. Cipoletti and P.E. Krajewski), Integrating Materials and Manufacturing Innovation, 2 (1), in press doi:10.1186/2193-9772-2-4 (2013)
81. “Stress evolution incomposite silicon electrodes during lithiation/delithiation,” (with V.A. Sethuraman, A. Nguyen, M.J. Chon, S.P.V. Nadimpalli, H. Wang, P. Guduru and D.P. Abraham), Journal of the Electrochemical Society **160**, A739-A746 (2013)
82. “Measurement and modeling of the mechanical and electrochemical response of amorphous Si thin film electrodes during cyclic lithiation,” (with G. Bucci, S.P.V. Nadimpalli, V.A. Sethuraman and P.R. Guduru), Journal of the Mechanics and Physics of Solids, **62**, 276-294, (2014)
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84. “Kinetics of Sn whisker nucleation using thermally induced stress,” (with F. Pei, C.L. Briant, H. Kesari and E. Chason), Scripta Materialia, **93** 16-19 (2014)
85. ‘Significance of nucleation kinetics in Sn whisker formation,” (with E. Chason, F. Pei, C.L. Briant, H. Kesari) Journal of Electronic Materials **43** (12) 4435-4441 (2014)
86. “On the mechanics of sinusoidal interfaces between dissimilar elastic-plastic solids subjected to dominant mode I,” (with F. Cordisco, P.D. Zavattieri, L.G. Hector), Engineering Fracture Mechanics, **131**, 38-57 (2014)
87. “Quantum-to-contnuum prediction of ductility loss in aluminium-magnesium alloys due to dynamic strain ageing,” (With S.M. Keravalarma and W.A. Curtin), Nature Communications **5**, 4604, (2014)
88. “Micromechanics of plastic deformation and phase transformation in a three-phase TRIP assisted advanced high-strength steel: Experiments and Modeling,” (with A. Srivastava, H. Ghassemi-Armaki, H. Sung, P. Chen and S. Kumar) Journal of the Mechanics and Physics of Solids, **78** 46-69 (2015)
89. “A continuum model of deformation, transport and irreversible changes in atomic structure in amorphous lithium-silicon electrodes,” (with E. Chason, P.R. Guduru and B.W. Sheldon), Acta Materialia **98**, 229-241 (2015)
90. “Analytical solutions for composition and stress in spherical elastic-plastic Lithium-Ion electrode particles containing a propagating phase boundary,” (with P.R. Guduru and E. Chason), International Journal of Solids and Structures, **69-70,** 328-342 (2015)
91. “Stress evolution in Lithium-Ion composite electrodes during electrochemical cycling and resulting internal pressures on the cell casing,” (with S.P.V. Nadimpalli, V.A. Sethuraman, D.P. Abraham and P.R. Guduru), Journal of the Electrochemical Society **162**, (14) A2656-A2663 (2015)
92. “Thermodynamics, stress, and Stefan-Maxwell diffusion in solids: application to small-strain materials used in commercial Lithium-Ion batteries,” (with D.R. Baker and M.W. Verbrugge), Journal of Solid State Electrochemistry, 163-181, (2016)
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95. “A multiscale approach to modeling formability of dual-phase steels,” (with A. Srivastava, L.G. Hector, Jr., J.E. Carsley, L. Zhang and F. Abu-Farha), Modeling and Simulation in Materials Science and Engineering, **24**, 025011, (2016)
96. “Swelling and elastic deformation of lithium-silicon electrode materials,” (with D.R. Baker and M.W. Verbrugge), Journal of the Electrochemical Society, **163**, A2647-A2659, (2016).
97. “In-situ synchrotron micro-diffraction study of surface, interface, grain structure and strain/stress evolution during Sn whisker formation,” (with F. Pei, N. Jadhav, E. Buchovecky, E. Chason, W. Liu, J. Tischler, G.E. Ice, and R. Xu), Journal of Applied Physics, **119**, 105302, (2016).
98. “In-situ measurement of solid electrolyte interphase evolution on silicon anodes using atomic force microscopy,” (with I. Yoon, D.P. Abraham, B.L. Lucht, and P.R. Guduru) Advanced Energy Materials, **6**, 1600099, (2016).

99. "Quantifying the rates of Sn whisker growth and plastic strain relaxation using thermally induced stress," (with F. Pei and E. Chason), Journal of Electronic Materials, **45**, 21-29 (2016).
100. 'Experimental calibration of a Cahn-Hilliard phase field model of phase transformations in Li-Sn electrrodes," (with S. Hulikal, C.H. Chen, and E. Chason), Journal of the Electrochemcical Society **643,** A2647-A2659, (2016).
101. "Stress evolution and whisker growth during thermal cycling of Sn films: A comparison of analytical modeling and experiments," (with Fei Pei, Eric Buchovecky and Eric Chason), Acta Materialia, **129**, 462-473 (2017)
102. "On the role of heterogeneity in phase-transforming electrodes: Origin of zero-current hysteresis," (with Srivatsan Hulikal), Journal of the Electrochemical Society, **164**, A1401-A1411 (2017)
103. "Water entry of deformable spheres," (with Randy C Hurd, Jesse Belden, Michael A Jandron, D. Tate Fanning and Tadd T. Truscott), Journal of Fluid Mechanics, **824**, 912-930, (2017)
104. "Stiffness of frictional contact of dissimilar elastic solids," (with JH Lee, Y. Gao, H. Xu and G.M. Pharr) Journal of the Mechanics and Physics of Solids, **112**, 318-333 (2018)
105. "Analysis and design of dual-phase steel microstructure for enhanced ductile fracture resistance," (with Daniel Gerbig, Ankit Srivastava, Shmuel Osovski and Louis G. Hector), International Journal of Fracture, **209**, p. 3-29 (2018)
106. "Water Walking: a new mode of free surface skipping," (with Randy C. Hurd, Jesse Belden, Sean Holekamp, and Michael A. Jandron," Scientific reports **9** (1) 6042 (2019)
107. "Kinetic Monte Carlo simulations of stress and morphology evolution in polycrystalline thin films," (with E. Chason), Journal of Applied Physics, 125 (11) 115304 (2019)
108. "Evolution of Microstructure and Creep Behavior in an Fe-Ni-Cr-Nb-C Alloy during service in hydrocarbon cracker tubes," (with D. Sun, C. Jeon, S. Kumar, I. Park, Y. Ro and R. Ayer, Journal of Materials Engineering and Performance **28** (11) 6588-6602 (2019)
109. "Analysis and design of a three-phase TRIP steel microstructure for enhanced fracture resistance," (With Z. Li, R. Kiran, J. Hu and L.G. Hector, International Journal of Fracture, 1-33 (available online at https://doi.org/10.1007/s10704-019-00405-6) (2019)

Book chapters

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2. "Three dimensional analysis of crack propagation in fiber reinforced composites," (with A. Xu and M. Ortiz), in Fracture and Damage in Quasi-Brittle Structures , ed. Z.P. Bazant, Z. Bittnar, M. Jirasek and J. Mazars, E&FN Spon, London, 589-604, (1994).
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Refereed conference proceedings

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9. "Cohesive zone models of void nucleation at interconnect interfaces," in `Stress Induced Phenomena in Metallization V,' ed. S. Baker and P.S. Ho, AIP Press, New York, **145**, (2002)
10. "Effects of passivation layer on stress relaxation in Cu line structures," (with D. Gan, S. Hoon, P.S. Ho, P. Cresta, N. Singh, J. Leu and S. Shankar), Proc IEEE International Interconnect Technology Conference, pp. 180-182, (2003).
11. "Atomic scale mechanisms of stress production in elastomers," (with J. Weiner) in Nanomechanics of Materials and Structures, Chuang, T.-j.; Anderson, P.M.; Wu, M.-K.; Hsieh, S. (Eds.), Springer, pp.161-170 (2005)
12. "Stress relaxation in patterned copper lines," Stress Induced Phenomena in Metallization, ed. P.S. Ho, AIP Press, New York pp 62-69 (2005)
13. "Rough surface plasticity and adhesion across length scales," (with Y.F. Gao), in Nanomechanics of Materials and Structures, Chuang, T.-j.; Anderson, P.M.; Wu, M.-K.; Hsieh, S. (Eds.), Springer, pp.277-275 (2005)

Unrefereed conference proceedings

1. "A ratchetting limit for plastic deformation of a quarter-space under rolling contact loads," (with K.L.~Johnson and J.~Kalousek), Proceedings of the 2nd International Symposium on Contact Mechanics and Wear of Rail/Wheel Systems, U.R.I., July 1986 .
2. "Development of a variational boundary integral method for the analysis of fully three dimensional crack advance problems," (with A. Xu, A. Argon, and M. Ortiz), in Computational Mechanics '95: Theory and Applications , ed. S. Atluri, G. Yagawa and T. Cruse, Springer, Berlin, 2 , 2874 (1995).

RESEARCH GRANTS

Current Research Support

- General Motors Collaborative Research Laboratory "Micro-mechanics of materials for automotive applications," (Director, with 2 other faculty) $1 000 000, 1/5/17 - 30/4/22)
- SK Corporation "Microstructural and Mechanical Property Modeling of Hydrocarbon Cracker Tubes," SK Corporation, (with Sharvan Kumar) $600 000 1/7/2017-31/12/2019
- National Science Foundation "Dependence of Sn whisker nucleation and growth on stress: real-time experiments and development of a predictive model," (With E. Chason), $154,268.00, 08/01/2019-07/31/2022

Prior research support

- IBM Thomas J. Watson Reseach Center, " Mechanical Reliability of Integrated Circuits," (with L.B. Freund), $48,500 1/1/92-12/31/92.
- N.S.F. MSS-921035 "Analysis of Failure Mechanisms in Thin Coatings," (PI) $90,000, 9/92 -- 2/96
- N.S.F. DDM-9016568 "Development of Computational and Experimental Capability for the Simulation of High Speed Machining," (A. Needleman, P.I., with R. Clifton, M. Ortiz and J. Duffy), $2,000,000. 9/91--22/95.
- NSF DMR-9302997 "Micro-- and Nano--Mechanics of Failure Resistant Materials, (R. Clifton, P.I.), $71, 499, 7/1/93/--8/30/96.
- ONR N00014-95-1-0239 "Mechanics of Materials: For Power--Electronics Control Devices," (L.B. Freund, PI) $680,00 10/1/94--9/30/97.
- Sandia National Laboratories, "Development of Phase Field Models for the Simulation of Electromigration and Stress Voiding in Interconnect Lines," (Co PI with A. Kumar) $70,000, 1/1/97 12/31/98
- Institute for Materials Engineering "Mechanics for Microelectronics," (Co- PI with L.B. Freund and K.S. Kim), $200 000, 1/1/97-31/7/99.
- NSF-CMS 9871240, "Acquisition of a high performance parallel workstation cluster for research in mechanics of materials,"(co PI, with R. Clifton, L. Freund, A. Needleman, R. Phillips) \$171,000, 7/30/98--6/30/01
- Semiconductor Research Corporation, "Mechanics of Defects at Interconnect Interfaces," (co PI with A. Needleman and V. Shenoy) $180,000, 8/1/99 12/31/01;
- NIST "Micro-mechanics of creep and corrosion crack growth in advanced ceramics," \$40 000 6/1/00 - 5/31/02
- NSF DMR-9632534 "Micro-- and Nano--Mechanics of Materials, (W. Curtin, P.I.), \$ 6 000 000, 9/1/00/--8/30/05.
- NSF CMS 0210095 "Study of self-organization in strained heteroepitaxial nanostructures: multi-scale modeling, simulation and experiment," (co PI with V. Shenoy, E. Chason and L.B. Freund), \$1 100 000, July 15 2002-June 30 2007.
- Intel Corporation, `Fundamental studies of electromigration reliability for future copper interconnects' $140,000 9/1/02-06
- Microstructure-based multi-scale modeling of the deformation behavior of Advanced High Strength Steels, Arcelor Mittal Corporation $114 000, 1/11/11-30/10/13,
- NSF DMR-9632534 "Micro-- and Nano--Mechanics of Materials, (IRG2 Thrust leader, with W. Curtin, director and E. Chason, IRG1 thrust leader), $ 9 000 000, 9/1/05/--8/30/13
- NSF-GR526071 "Conference: Industry/University Collaborations and the Materials Genome Initiative" $20 000 2012
- DE-SC0007074, DOE EPSCoR Implementation grant, "Mechanics of Li Ion Battery Materials" $6 000 000, 1/10/14 - 30/9/17) (Pradeep Guduru, Director, with 7 co-PIs)
- US Advanced Manufacturing Partnership and DOE "Integrated Computational Materials Approach to Development of Lightweight 3GAHSS Vehicle Sub-Assembly," $650 000 1/1/2013-12/31/2016 with S. Kumar

EXTERNAL SERVICE (Current only)

Panel and Proposal Reviewer for numerous funding agencies in US and abroad
Reviewer for numerous journals

UNIVERSITY SERVICE

Advisory Committee on Honorary Degrees, 1992-1994, Chair 1994
Committee on Admissions and Financial Aid, 1992-96
Engineering Executive Committee, 1997-99
Concentration Advisor, B.A. Engineering, 1995-98
Advisory Committee on University Planning, 1996-00, vice chair 2000
Concentration Advisor, Mechanical Engineering, 1998-2007. Prepared program for ABET visit 2001.
TEAM advisor (advisor to students with unusual advising needs), 2010 and 2011.
Steering Committee, MRSEC 2005-13 (thrust leader)
Freshman and Sophomore Advisor, 1991- (Currently advise 6 freshmen, 17 sophomores)
PhD Thesis committees (typically 3-5 per year)
Director, General Motors/Brown Collaborative Research Laboratory, 2004-
ABET accreditation coordinator, 2007-8, 2013-14
Chair, Engineering Concentration Committee 2007-2014
Director of graduate programs for solid mechanics 2012-2014
Director of Undergraduate Programs in Engineering, 2015-2019
NEASC accreditation Academic Credit Committee (co-chair) 2016

HONORS AND AWARDS

USCAR 2015 'Team' Award (2016)
Teaching with Technology Award, Brown (2015)
Midwest Mechanics Seminar Speaker (2013)
Brown University Royce Family Professor of Teaching Excellence (2012-2015)
Dedicated Faculty Award (presented by engineering class of 2013)
General Motors 'Most Valuable Colleague' award (2009)
Brown University Philip J Bray Teaching Award, (2003)
Institution of Mechanical Engineers Bronze Medal for Tribology, (1989)
Institution of Mechanical Engineers Thomas Stephen Prize, (1989)
Best Paper Award, Tribology Division, ASME (1988).

TEACHING

Graduate Courses

- EN02240 Elasticity (4x, Advanced grad course, enrollment 13)
- EN02210 Continuum Mechanics (2x Intro grad course, Enrollment 8)
- EN0222 Mechanics of solids (Intro grad course, 4x, enrollment 15)
- EN0229 Plasticity (3x, Advanced grad course, enrollment 11)
- EN2340 Computational Mecha**nics** (advanced grad course 3x, enrollment 17)
- EN2920 Mechanics of Contact and Friction (special topics, 1x, enrollment 20)

Undergraduate Courses. (2018 course shown bold)

- EN0003 Introduction to Engineering (freshman course, 5x as lead instructor, enrollment 160)
- **EN0040 Intro to Dynamics and Vibrations (freshman course, 15x lead instructor, enrollment 143)**
- EN0310 Mechanics of Solids (Junior course, 3x, twice as lead instructor, enrollment 70)
- EN1370 Advanced Dynamics (Junior/Senior course, 2x, enrollment 30)
- EN1310 Operations Research Projects (Senior course, 1x, enrollment 20)
- **EN0175 Advanced Solid Mechanics (Senior course 5x, enrollment 20)**
- EN0230 Surveying (Senior course, 1x, enrollment 5)
- EN1970 Independent studies (multiple – honors theses or independent design projects)

Ph.D. Students

1. Chijoke Mgbokwere, 1996 "Experimental study and micromechanical modelling of shear banding in an AISI 4340 VAR steel," Deceased.
2. Sonia Oliveira, 1996, "Failure mechanisms in coated solids under contact loading"
3. Deepali Bhate, 2001, "Diffuse interface model of void growth and migration in microelectronic interconnect lines," C.O.O. Edblox, inc.
4. Daniel Fridline, 2001 "Finite element modeling of electromigration and stress voiding in microelectronic interconnects," Assistant Professor, SUNY maritime college
5. Narendra Singh, "Numerical simulations of stress and electromigration in copper low-k interconnects," Ph.D., 2006, Caterpillar.
6. NingNing Du "Multiscale simulations of warm formability of Al alloys," Ph.D. 2009, Senior Engineer at Medtronic.
7. Juan Tello, "Numerical simulations of stress evolution during deposition of thin metallic films," Ph.D., May 2007, Ansys Corp.
8. David Cipoletti, 2011 "Deformation and microstructure evolution in polycrystalline Mg alloys," Ph.D., May 2011, now Visiting Assistant Professor of Engineering, Bucknell
9. Eric Buchovecky, 2010 "Stress relaxation and whisker formation in Sn films on Cu substrates", Senior Research Associate, Brown.
10. Viswanath Chintapenta "Theoretical modeling of lattice strain partitioning in nanocrystalline FCC metals,' 2012 now faculty member at IIT Kanpur
11. Peng Chen, "Microstructural modeling of deformation of dual-phase steels," 2014 now at Intel Corp.
12. Daniel Gerbig "Measuring and modeling the behavior of high-strength steels," 2017, now Senior Engineer at MSC Software.
13. Zhi Li, "Fracture of advanced high strength steels," (Co-advised with Huajian Gao) expected graduation date 2020.

Sc.M. Students

1. Michael Jandron "Application of Energy Finite Element Analysis to Submerged Structures," 2014
2. Zehan Deng "Multi-scale modeling of the influence of microstructural inhomogeneity on strain banding and formability in a TRIP assisted steel," 2016

Postdoctoral research associates

1. Yong-Wei Zhang 1996-1997, now program manager at Inst. for High Performance Computing, Singapore
2. Guy Genin 1997-1998 now associate professor at University of Washington St. Louis
3. Yanfei Gao 2003-2005, now associate professor at University of Tennessee
4. Yujie Wei, 2007-2008, now professor at Institute for Mechanics, China
5. Fan Zhang, 2006-2009, now Mechanical Engineer at Center for Reliable Energy Systems (CRES)
6. Eric Buchovecky (2011-2012) now Senior Research Engineer at Saint-Gobain USA.
7. Shyam Keravalarma (2011-2013) now assistant professor at IIT Madras
8. Giovanna Bucci (2012-13) now research associate at MIT
9. Ankit Srivastava (2013-2015), now assistant professor at U.T. Austin
10. Ravi Yellavajjala (2015-2016), now assistant professor at North Dakota State
11. Srivatsan Hulikal (2015-2017), now senior modeling engineer, Tesla
12. Dingyi Sun (2017-)
13. PeiPei Li (2019-)