

Parikshith K. Kumar

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Education

Ph.D. Materials Science & Engineering, Texas A&M University, 2009.

M.S. Aerospace Engineering, Texas A&M University, 2005.

B.E. Mechanical Engineering, Madras University, 2001.

Research

Postdoctoral Research Associate Spring 2010-Present

Dept. of Aerospace Engineering, TAMU, TX

Research effort includes developing Shape Memory Alloys for industrial applications as well as characterization of hybrid multifunctional materials. Establishing standards for testing SMAs as a member of the Consortium for Advancement of Shape Memory Alloy Research and Technology. Technical liaison between the university and industry for Smart Vehicle Concepts center to evaluate potential for new research areas and establish new projects.

Graduate Research Assistant (Doctoral work) 2005-2009

Texas A&M University

Influence of viscoplasticity on the actuation characteristics

The influence of viscoplasticity on the phase transformation in HTSMAs was investigated. A custom test setup was developed and experiments were designed to study the interaction of the two mechanisms. The associated microstructural changes were also analyzed. A deeper understanding into the interaction of the mechanisms was obtained and methods to minimize the influence of viscoplasticity were proposed.

Improving the actuation characteristics of HTSMAs

A new processing method was developed to improve the actuation strain and the work characteristics of HTSMAs by a factor of two. X-ray diffraction, optical microscopy and thermomechanical tests were systematically conducted on test specimens and the underlying microstructural changes responsible for the unique behavior was determined.

Design of downhole SMA actuator for oil industry

The aim of the collaborative project with *Schlumberger* was to develop a SMA actuator for the oil industry. Based on the design requirements a suitable HTSMA was selected for characterization. A new actuator was designed and developed in parallel. Optimized operational parameters were determined from thermomechanical testing and the finalized actuator prototype was successfully tested. Progress reports with detailed design drawings, test protocols and characterization results were submitted quarterly.

Influence of plasticity on the actuation characteristics

To effectively capture the influence of plasticity on the phase transformation behavior of SMAs, a methodology was developed to indirectly determine the evolution of the internal stress in the material

as a function of the applied stress and the test temperature. The methodology was validated by predicting the materials behavior in subsequent tests.

Graduate Research Assistant (Masters work) 2001-2005

Texas A&M University

- Selected a SMA composition and optimized the heat treatment to achieve the highest fatigue life under complete actuation
- Designed a gripping mechanism for thick wires and strips and developed a LabView controlled program for timed thermal actuation
- Investigated the influence of stress and actuation strain amplitude on the fatigue life of the SMA actuator and studied the failure mechanisms

Teaching

Texas A&M University

Guest Lecturer 2008-2011

Lectured in AERO 213 (*Material Science for Engineers*), AERO 404 (*Mechanics of Advanced Aerospace Structures*) and MSEN 601 (*Introduction to Materials Science*).

SMA Workshop Fall 2008

Prepared and presented the lecture on *Design Methodology for Engineering Applications* for the SMA workshop titled *Shape Memory Alloys: Fundamentals, Analysis, and Engineering Applications*.

Student Mentor Summers 2007, 2008 and 2009

Student mentor for the Undergraduate Student Research Grant (USRG) students assigning and guiding them through projects.

Employment

Intern January-May, 2001

LUCAS-TVS LTD., Chennai, India

The aim of this effort was to improve the alternator life by reducing thermal stress concentrations adjacent to the diodes. Experimental studies were conducted to understand the thermal distribution in the existing alternator heat sink design. FEA was performed and suitable design modifications to the heat sink design were suggested.

Intern June-August, 1999

Integral Coach Factory, Chennai, India

The aim of this effort was to suggest modifications to decrease the lead time to manufacture coaches. Studies on the company resources, machining, dwell and transit times were conducted. Modifications in plant layout and assembly schedules for individual coaches were suggested to decrease lead time.

Publications

Book Chapters

P. K. Kumar and D. C. Lagoudas, *Introduction to Shape Memory Alloys* in *Shape Memory Alloys, Modeling and Engineering Applications*, D. C. Lagoudas (Ed.), Springer, ISBN: 978-0-387-47684-1, 2008

J. A. Shaw, C. B. Churchill, D. C. Lagoudas, P. Kumar, *Shape Memory Alloys* in *Encyclopedia of Aerospace Engineering*, R. Blockley and W. Shyy (Ed.), John Wiley & Sons, Ltd., 2010

Journal Articles

- D. C. Lagoudas, G. Chatzigeorgiou and P. K. Kumar, *Modeling and Experimental Study of Simultaneous Creep and Transformation in Polycrystalline High Temperature Shape Memory Alloys*, Journal of Intelligent Material Systems and Structures, 2009
- D. A. Miller, D. C. Lagoudas, L. Rong, P. K. Kumar, *Thermomechanical Fatigue of Shape Memory Alloys*, Smart Materials and Structures 18, 2009
- P. K. Kumar and D. C. Lagoudas, *Experimental and Microstructural Characterization of Simultaneous Creep, Plasticity and Phase Transformation in $Ti_{50}Pd_{40}Ni_{10}$ High Temperature Shape Memory Alloy*, Acta Materialia 58, 2010
- P. K. Kumar, U. Desai, J. Monroe, D. C. Lagoudas, I. Karaman, G. Bigelow, R. Noebe, *Modeling and Experimental study of Simultaneous Creep, Plasticity and Transformation of High Temperature Shape Memory Alloys during Cyclic Actuation*, Materials Science and Engineering: A, In Press, 2011
- Y. Chemisky, G. Chatzigeorgiou, P. K. Kumar, D. C. Lagoudas, *A Constitutive Model for Cyclic Actuation of High-Temperature Shape Memory Alloys*, Journal of Intelligent Material Systems and Structures (submitted)
- P. K. Kumar and D. C. Lagoudas, *Tensile Transformation Behavior and Actuation Characteristics of $Ti_{50}Pd_{40}Ni_{10}$ High Temperature Shape Memory Alloy*, Acta Materialia (submitted)

Proceedings

- D. C. Lagoudas, P. B. Entchev and P. K. Kumar, *Thermomechanical Characterization SMA Actuators under Cyclic Loading*, Proceedings of IMECE-03, ASME, 2003
- P. K. Kumar, D. C. Lagoudas, K. Zanca and M. Z. Lagoudas, *Thermomechanical Characterization of High Temperature SMA Actuators*, Proceedings of SPIE Vol.6170, Smart Structures and Materials, 2006
- P. K. Kumar and D. C. Lagoudas, *Thermomechanical Characterization of a TiPdNi High Temperature SMA under Tension*, Proceedings of SPIE Vol.6526, Behavior and Mechanics of Multifunctional and Composite Materials, 2007
- D. C. Lagoudas and P. K. Kumar, *Interaction of Creep with the Martensitic Transformation in TiPdNi High Temperature Shape Memory Alloys*, The 8th European Symposium on Martensitic Transformations, 2009
- P. K. Kumar and D. C. Lagoudas, *Creep Behavior in TiPdNi High Temperature Shape Memory Alloy*, Proceedings of SPIE Vol. 7289, Behavior and Mechanics of Multifunctional Materials and Composites 2009
- P. K. Kumar, U. Desai, G. Chatzigeorgiou, D. C. Lagoudas, J. Monroe, I. Karaman, R. Noebe, G. Bigelow, *Experiment and Modeling of Simultaneous Creep, Plasticity and Transformation of High Temperature Shape Memory Alloys During Cyclic Actuation*, In: Proceedings of the 51st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Orlando, Florida, AIAA 2010-2992.
- P. K. Kumar, C. Kaer, G. Atkinson, E. Patoor, D. C. Lagoudas, *The Influence of Stress and Temperature on the Residual Strain Generated During Pseudoelastic Cycling of NiTi SMA Wires*, Proceedings of SPIE, 2011

Presentations

Thermomechanical Characterization of High Temperature SMA Actuators, SPIE Smart Structures and Materials/NDE Conference, San Diego, March 2006

Thermomechanical Characterization of TiPdNi High Temperature SMAs, SPIE Smart Structures and Materials/NDE Conference, San Diego, March 2007

Transformation Behavior in TiPdNi High Temperature Shape Memory Alloy, ASME Applied Mechanics and Materials Conference, University of Texas at Austin, June 2007

Effect of Heat Treatment on the Transformation Behavior of High Temperature Shape Memory Alloys, 44th Annual Technical Meeting Society of Engineering Science, Texas A&M University, October 2007

Characterization of Ni-rich $Ti_{50}Pd_{25}Ni_{25}$ High Temperature Shape Memory Alloy, SPIE Smart Structures and Materials/NDE Conference, San Diego, March 2008

Transformation Behavior and Actuation Characteristics of a $Ti_{50}Pd_{40}Ni_{10}$ High Temperature Shape Memory Alloy, International Conference on Martensitic Transformations, Santa Fe, June 2008

Actuation and Transformation Characteristics of Pd-based High Temperature Shape Memory Alloys, 45th Annual Technical Meeting Society of Engineering Science, University of Illinois Urbana Champaign, October 2008

Effects of Severe Plastic Deformation and Quaternary Additions on the Dimensional Stability of NiTiPd High Temperature Shape Memory Alloys, 45th Annual Technical Meeting Society of Engineering Science, University of Illinois Urbana Champaign, October 2008

Plasticity in TiPdNi High Temperature Shape Memory Alloys, 45th Annual Technical Meeting Society of Engineering Science, University of Illinois Urbana Champaign, October 2008

Inelastic Phenomena in TiPdNi High Temperature Shape Memory Alloys, SPIE Smart Structures and Materials/NDE Conference, San Diego, March 2009

Effect of Irrecoverable Strains on the Martensitic Transformation of TiPdNi High Temperature Shape Memory Alloy, ASCE/ASME/SES Conference on Mechanics and Materials, Virginia Polytechnic Institute and State University, June 2009

Interaction of Creep with the Martensitic Transformation in TiPdNi High Temperature Shape Memory Alloys, The 8th European Symposium on Martensitic Transformations, Prague, September 2009

The Influence of Stress and Temperature on the Residual Strain Generated During Pseudoelastic Cycling of NiTi SMA Wires, SPIE Smart Structures and Materials/NDE Conference, San Diego, March 2011

Leadership

President, India Association, Texas A&M University, 2004-2005

Treasurer, India Association, Texas A&M University, 2003-2004

Student advisor, Board of Student Affairs, Madras University, 1999-2001

Awards and Honors

3rd Place, Best presentation, Student Research Week, 2008

Best interdisciplinary research award, Student Research Week, 2008

1st Place, Best presentation, Student Research Week, 2007

Skills

Technical

Transmission electron microscopy, optical microscopy, metallography etching, differential scanning calorimetry, nano-indentation, thermomechanical and creep testing, heat treatment methods (for recovery, solutionizing or precipitation hardening), MTS Teststar II systems.

Computer

Operating Systems: Windows, Linux (Ubuntu), Mac OS X

Programming Languages: C, C++, LaTeX, Maple, MATLAB

Software packages: AutoCAD, Adobe Photoshop, and MS Office (Word, Excel, PowerPoint)