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MODELING THE MECHANICS OF SHAPE MEMORY POLYMERS

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ABSTRACT:

Shape memory polymers have the ability to retain a temporary shape, which can be reset to the original shape with the use of a suitable trigger, typically an increase in temperature, exposure to light and other mechanisms. These temporary shapes can be very complex, varied and the deformations involved large. These materials are finding use in a large variety of important applications ranging from aerospace to biomedical to sensors/actuators; hence the need to model their behavior. The this talk will provide an overview of the different types of shape memory polymers, in particular crystallizable shape memory polymers and light activated polymers. In crystallizable shape memory polymers the temporary shape is fixed by a crystalline phase, while return to the original shape is due to the melting of this crystalline phase. For light activated shape memory polymers exposure of the polymer to UV light at a specific frequency initiates the formation of cross-links that are responsible for the temporary shape. Exposure to UV light of a different frequency is responsible for cleavage of these cross-links and return to the original shape. In this talk we will discuss the underlying mechanisms and our approach to formulating constitutive equations to model the thermo-mechanical behavior of these polymers. The modeling is done within the framework of natural configurations utilizing a full thermodynamic approach. The application of the models developed to different boundary value problems of interest will be discussed.

BIOGRAPHY:

Dr. Joga Rao is a Professor in and Chair of the Department of Mechanical and Industrial Engineering at the New Jersey Institute of Technology. His research interests are in the areas of continuum mechanics and constitutive modeling. This includes the modeling of non-linear phenomenon observed in mechanics with an emphasis on applications in smart materials, non-linear solids and polymers. He is currently working on the mechanics of smart materials, in particular a variety of shape memory polymers, such as light activated shape memory polymers, crystallizable shape memory polymers and multi-functional polymers that respond to multiple stimuli. Other areas of research include mechanics of soft materials, biological tissues, polymers and the mechanics of creep in superalloys. His research has been funded by the National Science Foundation, Department of Energy and the Air Force. Dr. Rao received his Ph.D. from the Department of Mechanical Engineering, Texas A&M University, M.S. from University of California, Berkeley and B.Tech. from the Indian Institute of Technology, Bombay