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Assessing Creep Mechanism Through Strain Transient Experiments

Creep deformation of pure metals, solid solution alloys and particle-strengthened materials can be described by a variety of phenomenological equations. These creep "laws" typically relate the steady state strain rate to the stress, temperature and relevant microstructural features. Frequently, the steady state results for a given class of materials can be described by more than one such phenomenological relationship, leading to an incomplete understanding of creep behavior and the underlying rate controlling mechanisms. A more nuanced understanding of high temperature deformation and an ability to evaluate the applicability of various phenomenological relationships can be developed by examining the way in which a creeping solid responds to an instantaneous change of deformation conditions. Specifically, the transients in the strain-time response that result from a change in applied stress can be interpreted both qualitatively and quantitatively. Successful models must be able to describe both steady state and transient creep behavior. The purpose of this talk is to review work on creep transient experiments and outline how this approach can be used to develop appropriate descriptive relationships based on the thermodynamics and kinetics of slip, with an emphasis on providing a coherent picture that crosses classes of materials.

Biosketch

Jeffery C. Gibeling is a Professor and Chair in the Department of Materials Science and Engineering at UC Davis. His teaching and research interests are in the area of mechanical behavior of materials, including the study of fundamental deformation mechanisms, high temperature creep deformation, fracture and fatigue. He explores these phenomena in a wide variety of materials, including metals, metal matrix composites, layered materials and cortical bone. He is nationally and internationally recognized for developing new techniques for high-precision measurements of the mechanical response of materials to applied stresses in order to better understand the fundamental atomic-level processes controlling deformation. From 2002 to 2016, Professor Gibeling served as Vice Provost – Graduate Education and Dean – Graduate Studies at UC Davis, where he was responsible for the administration of 90 graduate degree programs. In his role as Vice Provost and Dean, he provided national and international leadership for graduate education issues. Professor Gibeling began his career at UC Davis in 1984 as Assistant Professor of materials science and engineering. He holds a bachelor's degree in mechanical engineering and a master's degree and Ph.D. in materials science and engineering, all from Stanford University.

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