Homogenization of elastic-viscoplastic heterogeneous materials: Application to nanomaterials

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The purpose of this talk is to present new homogenization schemes for the prediction of the mechanical behavior of elastic-viscoplastic heterogeneous materials. In a first part, Mori-Tanaka and self-consistent approaches are developed based on an interaction law postulated by Molinari et al (Mech. Mater., 26, 43, 1997). Illustrations are given for a two phase composite materials. In a second part of the present talk, we would like to emphasis how simple homogenization technique can be useful for the prediction of the mechanical behavior of nanomaterials. Based on previous rigid viscoplastic models proposed by Kim *et al.* (Acta Mater, 48:493, 2000) and Kim & Estrin (Acta Mater, 53:765, 2005), the nanocrystalline material is described as a two phase composite material. Using the Taylor-Lin homogenisation scheme in order to account for elasticity, the yield stress of nanocrystalline materials can be evaluated. The transition from a Hall-Petch relation to an inverse Hall-Petch relation is defined and is related to a change in plastic deformation mode in the crystallite phase from a dislocation glide driven mechanism to a diffusion-controlled process.