Huang, Y., **Zhang, F.**, Hwang, K., Nix, W., Pharr, G., and Feng, G., A Model of Size Effects in Nano-Indentation, Journal of the Mechanics and Physics of Solids, 54, 2006, pp. 1668–1686

Abstract

The indentation hardness–depth relation established by Nix and Gao [1998. Indentation size effects in crystalline materials: a law for strain gradient plasticity. J. Mech. Phys. Solids 46, 411–425] agrees well with the micro-indentation but not nano-indentation hardness data. We establish an analytic model for nano-indentation hardness based on the maximum allowable density of geometrically necessary dislocations. The model gives a simple relation between indentation hardness and depth, which degenerates to Nix and Gao [1998. Indentation size effects in crystalline materials: a law for strain gradient plasticity. J. Mech. Phys. Solids 46, 411–425] or micro-indentation. The model agrees well with both micro- and nano-indentation hardness data of MgO and iridium.

Keywords

Nano-indentation hardness, Maximum allowable density of geometrically necessary dislocations, Taylor dislocation model, Indenter tip radius