

Zhang, F., Huang, Y., and Hwang, K., The Indenter Tip Radius Effect in Micro- and Nanoindentation Hardness Experiments, Acta Mechanica Sinica, 22, 2006, pp. 1-8

Abstract

Nix and Gao established an important relation between the microindentation hardness and indentation depth. Such a relation has been verified by many microindentation experiments (indentation depths in the micrometer range), but it does not always hold in nanoindentation experiments (indentation depths approaching the nanometer range). Indenter tip radius effect has been proposed by Qu et al. and others as possibly the main factor that causes the deviation from Nix and Gao's relationship. We have developed an indentation model for micro- and nanoindentation, which accounts for two indenter shapes, a sharp, conical indenter and a conical indenter with a spherical tip. The analysis is based on the conventional theory of mechanism-based strain gradient plasticity established from the Taylor dislocation model to account for the effect of geometrically necessary dislocations. The comparison between numerical result and Feng and Nix's experimental data shows that the indenter tip radius effect indeed causes the deviation from Nix-Gao relation, but it seems not be the main factor.

Keywords

Taylor dislocation model, Strain gradient, Plasticity, Indentation, Nix-Gao relation