

Qu, S., Huang, Y., Nix, W., Jiang, H., **Zhang, F.**, and Hwang, K., Indenter Tip Radius Effect on the Nix–Gao Relation in Micro- and Nanoindentation Hardness Experiments, Journal of Materials Research, Vol. 19, no. 11, 2004, pp. 3423-3434

Abstract

Nix and Gao established an important relation between 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). We have developed a unified computational model for both micro- and nanoindentation in an effort to understand the breakdown of the Nix–Gao relation at indentation depths approaching the nanometer scale. The unified computational model for indentation accounts for various indenter shapes, including a sharp, conical indenter, a spherical indenter, and a conical indenter with a spherical tip. It 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 unified computational model for indentation indeed shows that the Nix–Gao relation holds in microindentation with a sharp indenter, but it does not hold in nanoindentation due to the indenter tip radius effect.

Keywords

Taylor dislocation model, Strain gradient plasticity, Indentation, Nix Gao relation