PARAMETRIC DISLOCATION DYNAMICS IN MULTI-LAYER THIN FILMS

N. M. Ghoniem, X. Han and Z. Wang

University of California at Los Angeles
Los Angeles, CA 90095
ghoniem@ucla.edu

A variety of applications at the nano- and micro-scales (e.g. micro-electronics, quantum dots, ultra-strong nano-layers, etc.) require accurate determination of the elastic field of 3-D dislocations in thin films. Knowledge of 3-D dislocation motion and transmission in multi- layer, isotropic or anisotropic thin films is essential to understanding their strength, failure properties, and processing requirements. We present an extension of our Parametric Dislocation Dynamics (PDD) to the conditions of multi- layer thin films. A double Fourier Transform (FT) on the coordinates parallel to the thin film surface is used to solve the elasticity problem in the direction normal to the thin film plane, satisfying traction and displacement boundary conditions at the interfaces and the free surface. Inversion of the FT results in the establishment of the stress field of 3-D dislocation loops of arbitrary geometry (e.g. crossing different layers –threading dislocation -, confined in single layers, at the interfaces, or emerging from the free surface). First, the characteristics of the elastic field of circular dislocation loops in isotropic and anisotropic multi- layer thin films will be discussed. PDD applications to Confined Layer Slip (CLS), threading dislocation motion and dislocation loop inter-layer penetration will then be presented.