Continuum approximation of the Peach-Koehler force on dislocations

Xiang Yang

Abstract

Dislocations are line defects and carriers of plastic deformation in crystals. We derive a continuum model for the Peach-Koehler force on dislocations in a slip plane. To represent the dislocations, we use the disregistry across the slip plane, whose gradient gives the density and direction of the dislocations. The continuum model is derived rigorously from the Peach-Koehler force on dislocations in a region that contains many dislocations. The resulting continuum model can be written as the variation of an elastic energy that consists of the contribution from the long-range elastic interaction of dislocations and a correction due to the line tension effect.