Elastic-Plastic Interaction of a Griffith Crack with a Wedge Disclination Dipole in an Inclusion-Matrix System

†*M. Fan[1]

[1]State Key Laboratory of Mechanics and Control of Mechanical Structures,
College of Aerospace Engineering,
Nanjing University of Aeronautics & Astronautics, China
*Presenting author: mfanz@nuaa.edu.cn
†Corresponding author: mfanz@nuaa.edu.cn

Abstract

The problem of a Griffith crack interacting with a nearby wedge disclination dipole is studied in this work. The crack is modelled by the distributed dislocation method, which results to a set of singular integral equations with Cauchy kernels and can be solved numerically. The Irwin plastic zone correction method is employed to improve the fracture analysis based on the linear elastic fracture mechanics. The von Mises yield criterion is applied to differentiate the elastic and plastic deformation at the crack tips. It is known that a disclination is a strong source of internal stresses and energy. As an attempt to explore the elastic-plastic fracture behavior of a Griffith crack interacting with a nearby wedge disclination dipole, we emphasized the influence of the wedge disclination dipole strength, arm length, and relative position to the crack and the inclusion. Numerical results showed that the wedge disclination dipole strength and arm length and can greatly influence the fracture behavior of the crack, even these values are very small. The effect was dependent on the position of the wedge disclination dipole. The maximum values the plastic zone size and crack tip opening displacement could be achieved when the wedge disclination dipole was near to the studied crack tip but not along the crack line. When the wedge disclination dipole was parallel to the crack line, the plastic zone size and the CTOD had larger values than the rest cases.

Keywords: Wedge disclination dipole, Griffith crack, Plastic zone, CTOD, Stress intensity factor.