INDENTATION RESPONSES OF SOFT MATERIALS UNDER A BIAS

Weiqiu Chen
Zhejiang University

ABSTRACT

In this work, three-dimensional exact solutions of adhesive contact between a pre-deformed compressible soft electroactive half-space and an axisymmetric rigid indenter are first presented. The change of surface adhesion energy during the contact is examined by using the modified JKR model, which accounts for the real contact area instead of the projected area. With the help of new results in the potential theory method, all physical (field) variables are derived in terms of elementary functions for three common types of axisymmetric indenters (flat-ended, conical, and spherical). The analytical contact relations for different indenter geometries and material properties are provided, which can serve a solid base for revealing the underlying electromechanical mechanism of soft electroactive materials. For numerical illustration, neo-Hookean isotropic electroactive material is considered. The simulation results clearly demonstrate that both the mechanical and electric biasing fields significantly affect the indentation measurement of the electroactive material. Moreover, at either micro- or nano-scale, adhesion is found to play a prominent role in the indentation responses.