

Mechanics of adhesion on a wavy surface

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Abstract

Several insect attachment devices consist of a *smooth (soft)* surface. An example is the green bush cricket. This work deals with the role of roughness in smooth pad attachment. Our intuitive notion of contacting surfaces tells us that roughness reduces adhesion. However, there is experimental evidence in literature, which suggests that this need not always be true. Briggs and Briscoe showed that when a roughened perspex sphere is separated from a soft rubber surface, the pull-off force first increases with roughness, reaches a maximum and then begins to decrease. In this work, we show that unstable crack propagation between a soft insect pad and a rigid rough surface can dissipate mechanical energy, leading to interfacial toughening and stronger adhesion. We investigate the effect of this instability on the macroscopic energy of separation and the maximum pull-off force, by means of analytical modeling and AFM experiments.