Geometry Induced Anisotropic Friction in Biological Systems

P.R. Guduru and J.F. Waters
Division of Engineering, Brown University, Providence, RI 02912
Pradeep_Guduru@Brown.edu

Abstract

Among the species with nanoscale *hairy* attachment systems, the hair structure is required to achieve two conflicting functions: good adhesion and easy detachment. This duality is essential in insect locomotion. There are several different shapes and structures found in nature, which appear to accomplish these conflicting functions, the underlying principle for which seems to be a strategic interaction between hair geometry and contact mechanics. The particular hair tip geometry of interest in this investigation is that of the fly *Calliphora vicina*. The tip is shaped such that the contact geometry resembles a "horseshoe" or an "incomplete circle." It is thought that this geometry, combined with adhesion mechanics, results in a lower sliding resistance in one direction compared to other directions. Interaction between geometry and adhesion can provide a switch between attachment and detachment. In this work, we report an experimental investigation on the anisotropic frictional behavior of nanoscale horseshoe pillars using atomic force microscopy and the results quantify the friction anisotropy.