Texas Tech University
Department of Chemical Engineering
Seminar Series

Nature inspired fibrillar adhesives: Controlling adhesion with geometry and material gradients

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Abstract

Most natural organisms are covered with hairy surfaces, which serve unique functions. In organisms like geckos and beetles, their hairy feet provide them with the amazing ability to scale practically any surface, independent of chemical composition and roughness. While synthetic analogues of these natural adhesives have shown great promise, two main features of the natural adhesives are yet to be matched: the high elastic modulus of the fibers and the ability of the gecko and others to scale rough surfaces. Recent discoveries suggest that the fibers forming these adhesive pads are of composite construction employing a gradient in elastic modulus and are curved rather the vertically aligned. I'll show how stiff composite fibers can be used to improve adhesion to rough surfaces, and how adhesion is related to layer thicknesses and roughness amplitude. I'll also show results from another type of composite fiber, resembling the joint like features in ladybird beetles, improving both adhesion and friction. Finally, high friction, low adhesion surfaces comprised of curved microplates will be explained. These surfaces can generate friction coefficients up to 6 with minimal adhesion, making them ideal for semiconductor manipulation and tire applications.

Bio

Dr. Aksak is currently an Assistant Professor in Mechanical Engineering and the Director of Bioinspired Mechanics and Systems (BIOMS) Lab at TTU. Dr. Aksak earned his bachelor's degree in 2003 in Mechanical Engineering at Middle East Technical University in Ankara, Turkey. He received his masters and doctorate degrees in Mechanical Engineering from Carnegie Mellon University (CMU) in 2005 and 2008, respectively. Prior to joining TTU in 2012, he cofounded nanoGriptech LLC in 2009 to commercialize nature inspired adhesives. He has 15 journal papers and 6 issued patents in the field of nature inspired adhesives. His work has been funded by NSF, DOD, and Air Force Office of Scientific Research.

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