>>> ANNOUNCEMENT

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Discovery and Engineering of New Adhesive Designs based on Lessons from Nature: Pollen

ABSTRACT

Nature provides remarkable examples of adhesive bioparticles that function in a wide range of environmental and dynamic conditions. This talk will review recent discoveries of the roles of solid-liquid interfaces in governing adhesion of plant pollens, as well as the application of these ideas in biomimicry for advanced adhesive design. Pollen microparticles provide robust examples of nature's solutions to adhesion in air under a wide range of humidities, transport conditions (wind vs. animal vectors) and on surfaces with a wide variety of structures and chemistries. While the adhesion mechanisms have previously not been well understood, these lessons could upon new opportunities in designing tunable wet-dry adhesives for composites, sensors, drug-delivery, wound closure, coatings, and adsorbents. Two separate pollen adhesion mechanisms have been identified recently by the author's group: a dry adhesion mechanism (determined by pollen surface geometry) and a capillary liquid-solid mechanism (determined by presence of a nanoscale liquid pollenkitt coating). These two mechanisms work together to give pollen the ability to 'tune' adhesion to different transport mechanisms (wind vs. insect pollenation) and to different surface chemistries. We will outline how the adhesive forces can be predicted by combining a capillarity model with the Hamaker adhesion model. Because of the small size scale of the pollen spine tips (~50 nm), capillary models of pollen adhesion must include a 'LaPlace' term that captures the large curvature of the liquid bridge. We have also discovered that the combination of solid spines or reticulate structures with the liquid pollenkitt coating also gives pollen a load-sensitive adhesion on rough or patterned surfaces. A third discovery that will be presented is the unique humidity sensitivity of the pollenkitt liquid coating, which allows for an enhanced adhesion to hydrophobic substrates under conditions of high humidity, contrary to intuition. This result derives from the changes in the dynamic characteristics of the pollenkitt, which derive from the fact that pollenkitt is a water-in-oil emulsion. Finally, several engineering applications as biomimicry-enabled sensors are reviewed.

BIO

present	Professor at the School of Chemical & Biomolecular Engineering at Georgia Institute of Technology, Atlanta, USA
2000	Assistant Professor at Georgia Institute of Technology, Atlanta, USA
1998 - 2000	National Research Council (NRC) Postdoctoral Associate at the National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, USA
1998	Ph.D. in Chemical Engineering, University of Texas, Austin, USA
1993	B.S. Chemical Engineering Degree, Georgia Institute of Technology, Atlanta, USA

June 20, 2014 at 2:30 pm

Leibniz Institute of Polymer Research, Max Bergmann Center of Biomaterials Dresden
Seminar Room B1, Ground Floor, Budapester Straße 27

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