**Materials Seminar**

Department of Materials Science & Engineering

# Tuesday March 6, 2018

2:15 – 3:15 ~ SERF 307

**Please join us for refreshments at 2:10**

"Examination of Adhesion through a Biomimetic Lens"

**Speaker: Mr. Michael Wilson, Graduate Student**



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Abstract:

Biomimicry has become a popular approach over the past few years, ranging in areas from aerodynamic train design to energy-efficient architecture. Biomimicry requires the understanding of natural systems from both a life-science point of view and physical-science point of view. With the combination of these viewpoints, novel understandings of underlying principles can lead to the development of innovative ideas and technologies. In this presentation, I highlight fundamental research from each of these viewpoints. First, the performance of the gecko adhesive system on various soft rubbers is tested using live animals. Gecko-inspired adhesives have been synthesized over the last fifteen years, and no synthetic fibrillar adhesive performs with the multi-functionality of the gecko’s adhesive system. In addition, there is still an incomplete understanding of the actual performance of the gecko adhesive system under various external factors, knowledge of which might aid in understanding the performance of synthetic systems.1 Anecdotally, It had been expected that geckos should not be able to stick to soft surfaces.2 However, there was no clear recognized definition of softness, and a preliminary study on PDMS suggested that a low surface modulus prevents the gecko from sticking. More recent research gives evidence that the lack of adhesion to PDMS by gecko seta is on account of other factors besides solely its surface softness. The second study in the adhesion of biological systems takes an entirely different approach, moving away from studying organisms to examining the role of functional groups in adhesion. It has been known that the acid-base interactions (of which hydrogen bonding is a subset) primarily determine the interfacial behavior of polymers. A framework is verified for 10 basic molecules which show that the acid-base interactions for small molecules with sapphire can be measured by examining the shift of the sapphire hydroxyl group in surface-sensitive sum frequency generation vibrational spectroscopy. With this technique, functional groups identified to serve in an adhesive capacity in natural systems can be probed to better understand their role in adhesion.

1. P.H. Niewiarowski, A.Y. Stark, A. Dhinojwala. Journal of Experimental Biology. (2016). 219:912-919

2. Langley, L. Geckos may be famously sticky, but here’s what stumps them. National Geographic Archived. (2016). URL: http://www.webcitation.org/6k9WFRHU2

Biography:

Michael Wilson is a fourth year graduate student in the department of Polymer Science at the University of Akron in the Dhinojwala research lab. In addition, he is a biomimicry fellow with the Biomimicry Research and Innovation Center at the University of Akron and is sponsored by Lubrizol Advanced Materials. He received his bachelor’s degree in Materials Science and Engineering from the University of Tennessee – Knoxville with a double major in German Language and Literature. His past research has included two internships at Oak Ridge National Laboratory performing high-rate tensile testing aided by visual image correlation and an internship at the University of Tennessee – Knoxville examining the phase behavior of doped cerium vanadates using x-ray diffraction. His current research focuses primarily on adhesion by biological systems. Part of his research examines the effect of external factors on the adhesion system of geckos by testing live animals and their shed toepads under various conditions. The other part of his research focuses on the role of acid-base interactions in wet adhesion systems using sum frequency generation vibrational spectroscopy.