Fabrication of Dry Adhesives mimicking the Gecko Adhesive System

Dr. Noshir Pesika
Tulane University
Chemical & Biomolecular Eng. Dept.
New Orleans, LA 70118
(504) 865 5771
npesika@tulane.edu

Overview

Nature has proven to be a tremendous resource for the development of novel technologies. As a result of evolution, several creatures have developed amazing abilities that are yet to be fully understood and reproduced. An example is the gecko lizard, which has the ability to run on walls and ceilings effortlessly. The fact that the geckos can adhere strongly to a surface and as importantly, detach easily has made the gecko adhesive system (GAS) an area of intense scientific interest. Although several aspects of the GAS are understood, research is still needed to fully understand all of its capabilities. An adhesive mimicking the GAS would have several potential applications including "smart" adhesives, sticky pads on robotic appendages, and friction pads in MEMS.

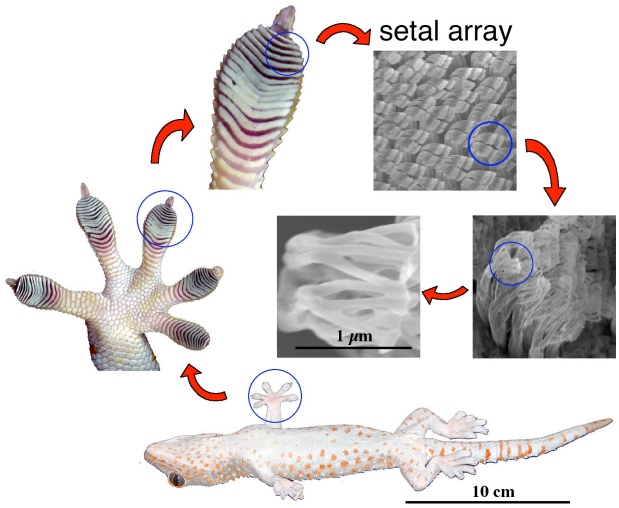

Figure 1: Hierarchical structures of a Tokay Gecko

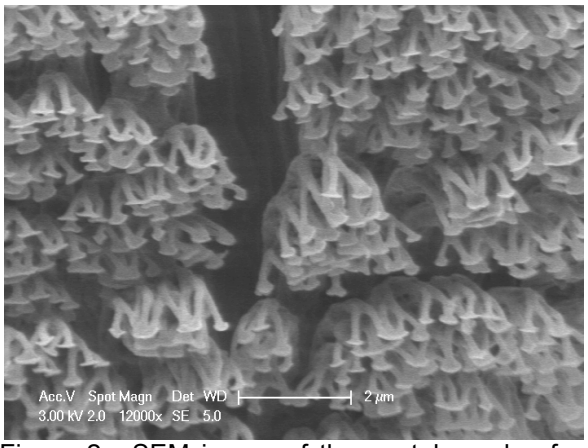

Figure 2: SEM image of the spatula pads of a Tokay Gecko

The complex hierarchical structures that makeup the GAS is shown in Figure 1. Each toe of the gecko contains a series on lamella-like structures called setal arrays. The setal arrays consist of a well-ordered fibrillar structures called setae (approximately 5 μm in diameter and 100 μm in length), which split into several spatulae shafts. The tips of the spatulae shafts form the spatula, a pad-like structure (approximately 10 μm thick and 200 μm in length and width) that comes into intimate contact with surfaces and allows for the strong adhesion dictated mainly by van der Waals forces although the chemistry of the surface has been found to also play a role recently. A high magnification view of the spatula pads in shown in Figure 2.

Over the last decade, several research groups have fabricated structures inspired by the GAS although none of the structures are able to fully replicate the level of efficiency and attachment/detachment mechanism. In addition, several of the prototypes rely on expensive fabrication steps that make the technology commercially unviable.

Objective:

In this project, you will help develop a multi-step fabrication scheme based on conventional as well as unconventional techniques to create polymer-based dry adhesives (inspired by the gecko). The resulting dry adhesives will include the important geometrical properties and characteristics (hierarchy, tilt angle and curvature of fibrillar structures, pad-like end structure) of the gecko adhesive system and are thus expected to operate on similar attachment/detachment mechanisms employed by geckos.