Micro- and Nano-structured Surfaces with Tunable Adhesion

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Surfaces/interfaces are thin
Nanostructures are small

Nanostructures are well-suited for manipulating surface and interface properties
What is tunable adhesion?

- Adhesion that can be controllably modulated from strong to weak
  - Strong adhesion when you need it
  - Weak adhesion when you want to separate an interface

- Many ways to control adhesion: chemistry, temperature, electric fields, etc., but **simplest control approach is the direction of loading**
Examples of tunable adhesion

Gecko image from: http://ben.biomimicry.net/tag/education/
Hierarchical structure that terminates in nanofibers yields strong and tunable adhesion

Y-Prize, http://yprize.upenn.edu/
Our technology

- **Surface structuring** (e.g., arrays of fibers)
  - **Compliant** – accommodate roughness
  - **Discontinuous** – disrupt crack propagation
  - **Redundant** – not all posts must be adhered

- **Composite fiber structure** to give **high adhesion** and **tunability**
Example data

Adhesion Enhancement

Adhesion Tuning

- Adhesion strength (normalized) vs. Normalized coating thickness
- Adhesion strength (normalized) vs. Normalized shear

Example data

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Adhesion Enhancement

Adhesion Tuning

- Edge Crack
- Center Crack

- Single material
- Composite

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Potential applications

- Manufacturing
- Robotics
- Consumer products
- Biomedical
- <Insert your idea here>