Switchable Adhesives for Space Applications
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Research Overview

Research Question: Can we develop a switchable adhesive that works consistently and controllably in space?

Background:
- The International Space Station uses robotic arms for maintenance.
- Many connections and arrangements available → Versatile maintenance device.
- Switchable adhesives → consistent, controlled attachment mechanism
- Testing in pressure vacuum and ~ +/- 150°C

Switchable Adhesives

Major inspiration:
- Gecko feet → hierarchical structure + biomechanics

Current Applications:
- Locomotion on smooth surfaces
- Pick and place

Current Switchable Mechanisms:
- Pre-compressive buckling
- Reduction of contact area
  - Mesh design [1]
  - Specified gripping/ releasing direction → triangles [2]
  - Magnetic field and cantilever beam control [3]

Experimental Setup

Figure 1: General trial for friction/adhesion characterization devices. [1]

Figure 2: Solidworks model for the entire setup.

Figure 3: Thermal analysis of internal components at lower limit ~160°C (left) and upper limit ~120°C for temperature.

Other Analysis and Considerations:
- Finite Element Analysis (FEA) for chamber under vacuum
- Temperature monitoring
- Heating and cooling stage
- Load cell in vacuum environment

References:

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