Materiali micro- e nano-strutturati con proprietà termiche e meccaniche controllabili

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Engineering Areas

- Extreme environments
- Deformable scaffolds
- Impact protection

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Materials for Extreme Environments

Gdutous et al. Experimental Mechanics, 2013
Yamamoto et al. Submitted 2013
Materials for Extreme Environments: Characterization

- Released flat: ~0.1-0.2 µm out-of-plane
- High yield > 95%
Materials for Extreme Environments: Optical Properties

Linear correlation coefficient:
Al: 0.53
Lattice: 0.89
Engineering Areas

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Structure/Function Relationship in Materials

**Self-cleaning**

- Images of lotus leaves showing water droplets.
- Text: "In the case of the 'lotus effect', the phenomenon of superhydrophobicity observed in lotus leaves and duck feathers, micrometer-scale papillae and epicuticular wax. More recently, the discovery of novel micro- and nanometer-scale features in biology received intense attention (Fig. 2), such as, the self-adhesion of sponge spurs due to their unique microstructure."

**Adhesion**

- Images of gecko feet and butterfly wings.
- Text: "Mechanical properties: gecko feet, octopus suckers, water strider, cicada wings, moth's toes, peacock feathers, butterfly wings, and beetle shells."

**Color**

- Images of butterfly wings and beetle shells.
- Text: "Optical properties: cicada wings, moth's peacock feathers, butterfly wings, and beetle shells."

**Xia et al., Adv. Mater., 2008**

"The selection of different principles from nature. Many scientific questions can be answered by understanding the correlation between the unique properties of special structure and corresponding chemical composition. This paper only discusses each principle (Section 2) and concludes with a recap. "The original hypothesis was that both high ferromagnetic and superhydrophobic properties observed in lotus leaves and duck feathers are a result of surface roughness caused by micrometer-scale papillae and epicuticular wax. More recently, hierarchical structures on the surfaces of lotus leaves, e.g., the 'lotus effect', the phenomenon of superhydrophobicity observed in lotus leaves and duck feathers, micrometer-scale papillae and epicuticular wax. More recently, the discovery of novel micro- and nanometer-scale features in biology received intense attention (Fig. 2), such as, the self-adhesion of sponge spurs due to their unique microstructure."
Impact Protection Materials

Multi-scale fibrous organization

Raney JR, et.al., Carbon, 2011.
Impact Protection Materials

> 200 times improved energy absorption at same density

Chiara Daraio et al., ACS Nano. 2011
Engineering Areas

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Deformable scaffolds

D. Little, HRL Laboratories

Deformable scaffolds

Seeking Partnerships to

- Develop collaborations
- Find applications
- Train students
- Find solutions to existing industrial problems

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