

# Soft Intelligent Materials and Devices: Multiscale Synthesis, Manufacturing, and Applications



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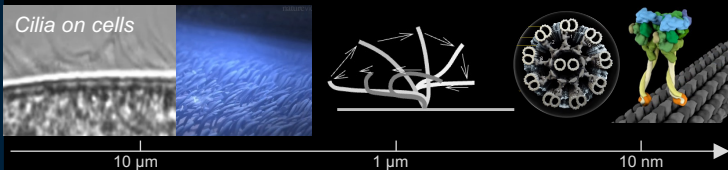
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## Research Vision

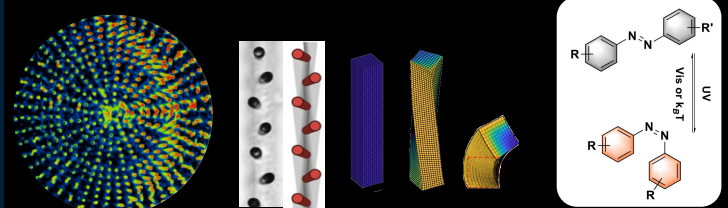
Li's group aims to develop 'life-like' soft materials that exhibit **complex responses** and **adaptation** for addressing challenges in soft robotics, sustainability, and healthcare. We currently focus on understanding and designing dynamic molecular switches, liquid crystal assemblies, and anisotropic actuating polymers through multiscale fabrication and characterization tools.

## Bio-inspired Designs

### 1. Multiscale hierarchical designs in nature



How do we synthetically mimic such complex dynamics?

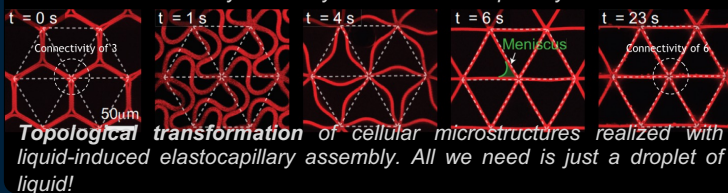


**Artificial Self-regulating "Cilia":** A photo-responsive polymeric pillar array can display programmable, complex "stroke-like" coordinated motions, with broad implications for autonomous multimodal actuators in areas of soft robotics, biomedical devices, and energy transduction materials.

### 2. Dynamic functional microstructures in nature



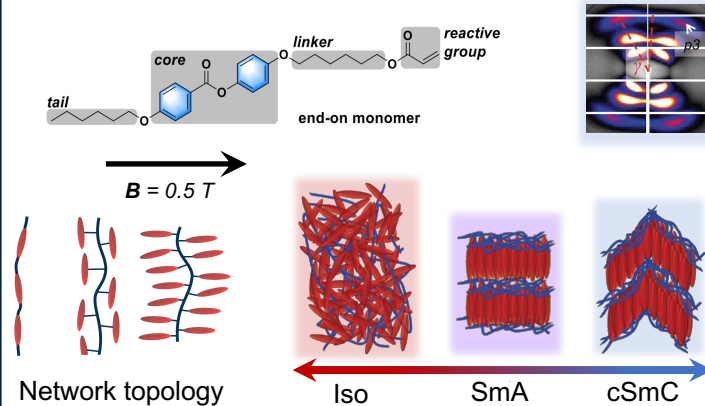
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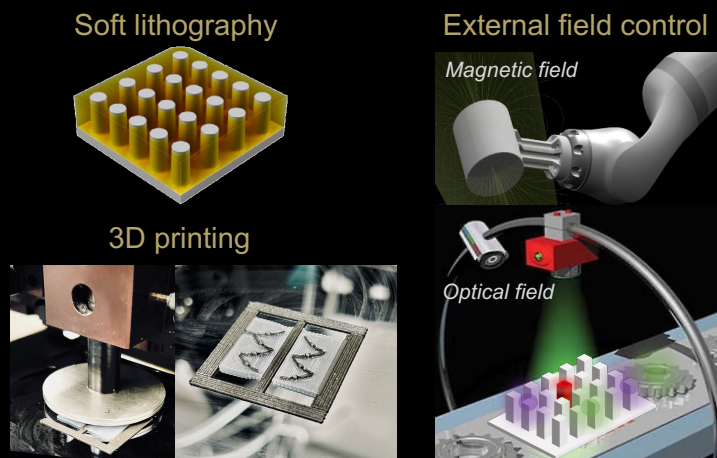
**Topological transformation** of cellular microstructures realized with liquid-induced elastocapillary assembly. All we need is just a droplet of liquid!

## Materials and Fabrication

### 1. Structure-property relationship in anisotropic actuating polymers, hydrogels



### 2. Structure-processing-property relationship multi-scale fabrication methods converging bottom-up and top-down approaches



## Broader Impact

- Passive Materials  
Structural Materials
- Active Materials  
Stimuli-responsive Materials
- Adaptive Materials  
Self-regulate Materials
- Life-like Materials  
Intelligent Materials

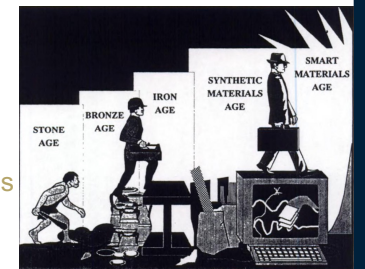


Fig. 2.1 The eras of materials science.

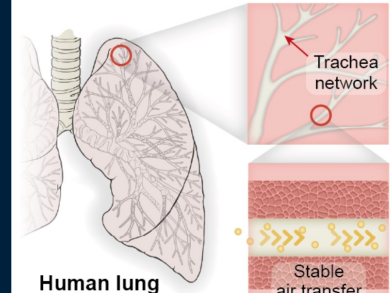
**The Material Is the Machine**  
Kaushik Bhattacharya and Richard D. James

Perspective  
**The rise of intelligent matter**

**Innovate**  
**dynamic soft materials**  
**for dealing with**  
**complex dynamic environments**

Human body environment      Natural environment

Human-machine interfacing materials  
Soft robotics



Water Harvesting in Death Valley

