

Artificial Leaves: Integrated Soft, Biological & Composite Mesoscale Systems for Enhanced Bioenergy Production

Opportunity

Urgent need for clean and economical *Energy* from biological systems is a viable means to mitigating the increasing global carbon emissions and their impact on climate change, while sustaining economic growth. Algal biofuel is sought to be one of the most promising bio-energy sources.

The challenges facing current technologies are:

- low energy conversion efficiencies (1-6%)
- high resource and water requirements
- limited environmental tolerance and geographic distribution
- biocontaminant constraints
- cultivation and harvesting costs (40% of overall biodiesel cost)

Meso Challenge

Electrokinetic phenomena at the mesoscale

Transport of CO₂ and nutrients in Mesoporous material structure

Cell interactions at the mesoscale (cell-cell; cell-interface)

In-situ characterization of non-destructive lipid extraction

Approach

Design, build, and evaluate the performance characteristics of Artificial Leaves based on integrated soft biological and composite materials that can reproduce the unique characteristics of terrestrial leaves and algae systems to enable enhanced economic and sustainable algal biofuel production.

Impact

- Enhanced energy capture and conversion
- Reduced water and nutrient requirements
- Enhanced productivity
- Reduced harvesting costs and increased robustness
- Reduced environmental and health impacts