We combine experiments and simulations to study structure-property performance correlation in nanofiber-based novel materials for energy storage and conversion devices such as fuel cells, supercapacitors, batteries and solar cells.

**INTRODUCTION- NANOFIBERS**

Nanofibers are fabricated via a process called electrospinning that uses strong electric field to accelerate and thin a polymer solution/melt jet forming nanoscale fibers.

Why Nanofibers?
- Nanofibers are 10-100 times smaller than those produced from conventional mechanical spinning
- High surface area leads to enhanced efficiencies in energy devices
- Interconnected porous structure with tunable porosity enhances mass transport
- Versatility of the electrospinning process leads to multi-functionalities via core-shell electrospinning

**NANOFIBERS FOR FUEL CELLS**

Proton exchange membrane fuel cell (PEMFC) converts the chemical energy liberated during the reaction between hydrogen and oxygen to electrical energy.

Limitation of State-of-the-art Fuel Cells: High cost of platinum catalysts has been one of the key challenges that has prevented the broad deployment of fuel cells for transportation application.

Objective: To study structure-property-performance correlation in nanofiber-based fuel cells that maximize triple phase reaction surfaces and enhance platinum utilization, thereby reducing cost.

Nano-engineered materials with simultaneous proton and electron conductivity

Addition of polyacrylonitrile enhances extensional viscosity of Nafion to enable electrospinning

**NANOFIBERS FOR SUPERCAPACITORS**

Supercapacitors (or electrical double-layer capacitors) are energy storage devices that store charge by adorbing ions on the surface of highly porous carbon materials.

Carbon nanofibers with well-controlled, hierarchical pore structure exhibiting specific surface area of 1500-2000 m²/g are ideal candidates for such devices.

**NANOFIBERS FOR BATTERIES**

Batteries are energy devices that convert chemical reaction energy to electrical energy. They can theoretically provide higher energy density than the state-of-the-art Li-ion batteries and therefore hold enormous potential for all-electric vehicles.

Critical Requirement for Successful Development of Li-air Batteries: Fabrication of nanostructured air cathodes that optimize transport of all reactants (air, Li⁺ ions, and electrons) to the active catalyst surfaces and provide enough spaces for solid lithium oxide products. Nanofibers with tunable porosity and internal structure will serve as excellent cathodes.

**FUNDING AND CONTACT**

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