**ACT 3: Self-Assembled Nanomaterials for Energy Generation and Storage**

- **Objective:** Incorporated solar energy conversion systems and energy storage devices into a flexible shelter.

- **Aim 1:** Increase solar energy conversion by designing multilayered polymer / nanoparticle coatings on optical waveguides to efficiently collect and convert light. Coatings will be compatible with the surfaces from ACT 1.

- **Aim 2:** Design and synthesis of new polymers for lightweight, flexible batteries.

- **GIANT**’s expertise in interrogating energy materials in-situ and in-operando is particularly unique.

Electricity is a vital resource following a disaster.

Silicon-based photovoltaic devices convert a limited range of solar wavelengths.

**Luminescent Solar Concentrators LSCs**

Design nanoparticle / polymer coatings to deliver every photon to the solar cells....
Quantum Dot Spectral Converters

QDs are rapidly being commercialized as down shifting lumophores in displays & solid state lighting.

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In-situ characterization of multi-layer solar-cell coatings

Spectroscopic Ellipsometry

Yokoyama, D., Sakaguchi, A., Suzuki, M. & Adachi, C.

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ACT3: ENERGY GENERATION/HYBRID SOLAR CELLS

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Biorganic synthesis
DNA engineering, self-assembly, conjugation, NP nanohybrids

Molecular synthesis
Coordination & Supramolecular Chemistry

Liquid Crystals
Surfactants
Self-assembly
Fullerene, Dendrimers

Block copolymers
Spin trapping

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Electrode in a Li-Ion batteries must transport ions, but not electrons.

DISCHARGING

Metal oxide
(Li intercalates a metal oxide)

Carbon Material
(Li de-intercalates)

Liquid Electrolyte
(typically a flammable liquid – salt mixture)

Solvate Li ions
Fast Li conduction


Higher energy densities are possible with Li-metal batteries, but there is a danger of fire.

Solid polymer electrolytes could provide a safe and flexible alternative for battery design.

Solid Polymer Electrolytes

✔ Less flammable than liquid electrolytes
✔ Requires less package (increase energy density)
✔ Mechanically robust to avoid dendrites
✔ Could be incorporated into fabrics
✔ Poor ion conductivity
Connectivity of nanoscale ionic domains may enhance conductivity.

Isolated ionic domains: ion transport is blocked by nonpolar matrix.

Percolated ionic domains: ion transport may occur without needing to traverse nonpolar matrix.

Layered ionic domains: ion transport is blocked by nonpolar matrix; ion transport may occur without needing to traverse nonpolar matrix.

In Progress: Structural characterization of layers in COOH precise polymers.

Structure-Conductivity Relationships
- In situ EIS and X-ray with %RH and T
- E

Structural Details of Layers
- Nanofocus X-ray beam: single crystal diffraction
- Atomistic MD

PIRE Act 3: Structure-conductivity relationships and structural details of layers.

Keywords, Core Competences, Research Lines & Approaches:
- Bio/Soft matter
- Neutron Scattering
- X-Ray Scattering