



Hybrid Nano Materials & Membranes for Water Purification, Energy, Medicine, Sensor, Catalyst

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Descriptions of Research Topics

- Graphene and clay composite nanofiber membranes for water purification
 - ➔ Removal of toxic materials: separation of heavy metals, dyes, and organic debris
 - Antifouling and antibacterial properties
- Highly reinforced nanofiber separators for rechargeable batteries
 - ➔ Thermally and mechanically stable PVdF and PI nanofiber membranes
- Nanogold and/or hydrogel polymer composites for biomedical sensors and catalyst systems
 - ➔ Enhancement of sensing capability and quasi-homogeneous catalytic systems
- Lead free X-ray shielding materials for medical applications

Applications:

- Water purification system, Battery separator, Medical device, Optical sensor, Catalyst

Functional polymer membrane

- Outstanding mechanical strength and permeability
- Log10⁴ antibacterial - 99% Pb, Cd, As removal
- Commercial-type membrane purification system
- Long-term stability and recovery for organic materials

Nanofiber based battery separators

- Thermal and long-term stability for secondary battery
- Development of hydrocarbon and nanofiber separator

Membrane performance

Polymer-clay composite nanofiber membranes

any amount of clay clay amount dependent

Organic solvent nanofiltration (OSN)

Process: Polymer solution → Filter → Coating → Drying → Spinning → Quenching → Breaker plate → Quenching bath → Take up roller

Lead free X-ray shielding composites

Inorganic/polymer binder

Developed composite Commercial product

Applied voltage (kV): 40kV, 60kV, 80kV, 100kV, 120kV

Optical sensor & Heat generation Materials

Paper base plasmonic substrate

Heating property

Temperature (°C) vs. Applied amount of AuNPs (mL)

4 mL → 12 mL

Filter paper Spray coating Dip coating

New generation catalytic system

Radical polymerization: Poly(NIPAM) + HAuCl₄ → Gold nanoparticles within poly(NIPAM)

Physically embed gold nanoparticle on polymer matrix

Reaction scheme: Oxidation of phenol to quinone, Reduction of nitrobenzene to aniline, Coupling of aniline to polyaniline.

- Base free and ligand free catalyst
- High reactivity and selectivity as well as recyclability

Research Fields 1 Nanoscale Material 2 Polymer Membrane 3 Environment 4 Optical Device
Keywords Graphene, Nanofiber, Membrane, Nanomaterials, Polymer, Composite, Water purification, Electrospinning, Separator, Rechargeable battery, SERS, Catalysis