

Polymer-Derived Multifunctional Materials For Sustainability

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This talk first covers an overview of the field of multi-functional polymer-derived materials with special emphasis on sustainability followed by discussion of several case studies drawn from our work on bi-component polymer nanofibers, mesoporous polymer aerogels, aerogel foams, and high temperature lithium ion batteries. In the first case study, nanofibers of interpenetrating network obtained from a hydrophilic and a hydrophobic polymer via gas jet method are used in efficient removal of water droplets from ultralow sulfur diesel fuel. In the second case study, strategies for manufacturing of open and closed cell aerogel foams from high internal phase emulsion methods are discussed. The resultant materials contain interconnected meso- and macroporosity and show fast absorption of hydrocarbon liquids, high permeability of air, and high efficiency of breaking water-in-oil emulsions. In the third case study, the gas jet fiber method is used in the fabrication of 1-100 μm long nanofibers of semiconducting metal oxides of TiO_2 , TiO_2/ITO , and $\text{TiO}_2/\text{V}_2\text{O}_5$ with side-by-side, core-shell, and nanorods-on-nanofiber arrangements offering stronger photocatalytic degradation of ethanol and splitting of water molecules under ultra-violet and visible lights. In the fourth case study, ionogel membranes based on syndiotactic polystyrene and ionic liquids are used to replace polyolefin-based separators and volatile organic electrolytes in lithium ion batteries for safe operations at temperatures up to 100 $^\circ\text{C}$.

References

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