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***Our Quest for New Materials for Next Generation Separation
and Purification Challenges***

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An interesting question that comes to mind is if we have sustainable material systems to combat next generation of purification challenges. An assortment of novel separation and purification media have assisted thus far in mitigation of technical challenges that we face in separation and purification industries. However, the fundamental understanding of separation mechanisms and the corresponding materials solutions quickly matured and cannot be extended easily to solve some of the emerging separation problems. The advent of electric vehicles and stricter limits set on release of certain organic molecules in water are posing new separation challenges. These problems are complex, involve cryogenic conditions, present stiff purification challenges, and cannot be addressed using conventional separation media. For example, hydrogen storage under cryogenic conditions and delivery of clean hydrogen to electrode of fuel cell are important for electric vehicles industries. However, only a handful of media can survive cryogenic conditions and can remove trace amounts of nitrogen oxides from hydrogen gas. The over usage of per- and polyfluoroalkyl substances (PFASs) in food packaging, as polymer additives, and for non-stick function of cooking utensils puts our drinking water systems at the risk of PFASs contamination. We need new affordable and sustainable separation media to combat such issues. This talk will discuss the materials landscape from current separation and purification industries and expand the scope to newer, sustainable materials systems such as the hybrids of nanofiber mat/aerogel laminates, upcycled 3D-printed polymer metamaterials, and aerogel-coated glass fibers for liquid-liquid separation, airborne nanoparticle separation, and small organic molecule separation from aqueous streams.