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Abstract Formulary

Presentation type: **Oral** ✔ **Poster** ☐

Title: Strategies for Preparing Hydrophobic and High-Strength Polyme

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ABSTRACT (Space limited to 2200 characters)

High-strength polymer aerogels are an increasingly important class of lightweight, multifunctional materials that combine the superlative thermal and acoustic insulating properties of traditional aerogels with the strength and durability expected of engineering materials. Unfortunately, most organic polymer aerogels are somewhat or very hydrophilic, and absorb significant amounts of water when submerged regardless of their contact angle. We have discovered that even polymer aerogels derived from difunctional monomers express a significant population of unreacted nucleophilic and electrophilic moieties on their surface, despite the belief that the reactive groups in the reaction medium used to form the gel were stoichiometrically reacted. Based on this finding, we have developed strategies for making polymer aerogels hydrophobic by introducing hydrophobes that feature reactive functional groups complimentary to these aerogel surface functional groups. Suitable hydrophobes include compounds featuring a hydrophobic moiety exhibiting a log P in the range of 1 to 4, for example, alkyl and aryl groups, along with a reactive functional group tailored for the particular polymer of interest, for example, amine or anhydride for polyimides, amine or isocyanate for polyurea, etc. Unlike hydrophobization of silica, the hydrophobe can be added to the sol directly as well as introduced diffusively during solvent exchange. As a representative example, a polyurea aerogel with a density of 0.11 g/cc, strength of ~43 MPa, stiffness of ~11 MPa, surface area of ~200 m2/g, and thermal conductivity of 23 mW/m-K can have its 24-hour water uptake reduced from 106 wt% to 10 wt% with no impact on any of the above properties. In this work we will discuss a large parametric study of hydrophobic polyurea aerogels and how important process parameters such as hydrophobe concentration, addition timing, and molecular composition affect the materials properties of the resulting aerogel.