Polymerizable Ionic Liquids for Gas Separation Membranes

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Room Temperature Ionic Liquids (RTILs) have shown much promise as materials usable for the storage and separation of gases. However, as liquids, the implementation of RTILs may be limited in applications where a solid material is required. Thus, polymerized RTILs are attractive, as they can maintain the desirable properties of the bulk liquids, while adding mechanical stability. The use of polymerized RTILs for materials applications is not without precedent. Several papers have been recently published exploring the ion-conductivity properties of RTIL-based polymers. However, their use as gas separation membranes is just beginning to be developed. Our group has utilized the versatile chemistry of imidazolium-based RTILs to successfully synthesize a variety of photopolymerizable RTILs. Through a straightforward process, we can fabricate large area, defect-free RTIL-based polymer films, and characterize the permeability, solubility, and diffusivity properties of light gases through these membranes. Our studies focus on the effects of the ion structure on polymer gas separation properties, and, specifically, on how the lengths of the alkyl substituents of the imidazolium cation affect material performance. Polymerized RTILs of this type have been observed to become more rubbery as the size of the cation increases. A first generation polymerized RTIL membrane was shown to have a CO_2 permeability of 60 Barrers, and a CO_2/N_2 ideal selectivity of 20.