# Enhancing Carbon Dioxide Capture: Composite Ionogel Membranes with Deep Eutectic Solvent-Ionic Liquid Blends for Efficient Gas Separation

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## Abstract

The rising levels of Carbon Dioxide have brought focus to the necessity of mitigating global warming. Deep eutectic solvents, serving as a possible alternative to ionic liquids, have recently emerged as a novel category of environmentally friendly solvents. They have also shown effective applications in gas separation. To improve the efficiency and cost-effectiveness of CO2 capture technology, a composite ionogel membrane is fabricated using a deep eutectic solvent and polymer. A novel composition of a DES dense membrane with pebax-1675 on a Polyvinylidene Fluoride (PVDF) porous support was employed for the separation of CO2 from a CO2/CH4 mixture. Fourier transform infrared spectra were acquired to confirm the formation of DES structure. The primary physicochemical characteristics of DES were determined within the temperature range of 293.15-333.15 K. The impact of different concentrations of DES on separation efficacy in terms of permeability and selectivity was examined. The gas separation efficiency of the proposed ionogel membrane was evaluated in both pure and mixed gas environments. The permeability achieved for the mixed gas was 197 Barrer when using a 15% concentration DES membrane. Numerical density functional theory (DFT) simulations were conducted to determine the interaction energies between DES and gas molecules. We compared the performance of DES ionogel membrane with existing DES-SLMs and demonstrated their potential as a viable substitute for current solvents in gas absorption and separation.

## Keywords

Deep Eutectic Solvents, CO2 capture, Gas Separation, Density Functional Theory, Ionogel membranes.