

Tuning Carbon Dioxide Capture Behavior via Ion Exchange in Porous Organic Polymers

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Carbon dioxide (CO₂) levels in Earth's atmosphere have increased dramatically in recent decades, and many strategies in carbon capture and sequestration have been investigated to remediate this problem. In this study, the capability of porous organic polymers (POPs) for CO₂ capture was investigated via the introduction of anions into the polymer. A methylation reaction and ion-exchange procedure in ethanol was performed on parent material POP-1 to successfully introduce the anions F⁻, Cl⁻, PF₆⁻, NO₃⁻, and BF₄⁻ into the polymer. Material characterization for N₂ at 77K, CO₂ at 273K, and CO₂ at 298K were then performed and analyzed through a comparison of surface area, CO₂ uptake, and heats of adsorption (Q_{st}). From various calculations and graphs of material behavior, it was concluded that the introduction of anions plays an important role in carbon dioxide interactions, but this addition of ions needs to be balanced with a large surface area. In particular, POP-1-BF₄ had the greatest Q_{st} of CO₂, signifying strong interaction – this is attributed to its relatively large surface area and presence of four fluoride ions. The need for balance between anions and surface area will play an important role in exploring further functionalities of POPs and their capability as a CO₂ adsorbent.