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(Qst). 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 Qst 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.