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Syntheses of Anionic Poly(urethanes) with Imidazolium, Phosphonium, and Ammonium as Counter-cations and Their Evaluation for CO2 Separation

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Abstract : The increasing level of carbon dioxide concentration in the atmosphere related to fossil fuels processing and utilization are contributing to global warming phenomena considerably. Carbon capture and storage (CCS) technologies appear as one of the key technologies to reduce CO2 emissions mitigating the effects of climate change. Absorption using amines solutions as solvents have been extensively studied and used in industry for decades. However, solvent degradation and equipment corrosion are two of the main problems in this process. Poly (ionic liquid) (PIL) is considered as a promising material for CCS technology, potentially more environmentally friendly and lesser energy demanding than traditional material. PILs possess a unique combination of ionic liquids (ILs) features, such as affinity for CO2, thermal and chemical stability and adjustable properties, coupled with the intrinsic properties of the polymer. This study investigated new Poly (ionic liquid) (PIL) based on polyurethanes with different ionic liquids cations and its potential for CO2 capture. The PILs were synthesized by the addition of diisocyante to a difunctional polyol, followed by an exchange reaction with the ionic Liquids 1-butyl-3-methylimidazolium chloride (BMIM Cl); tetrabutylammonium bromide (TBAB) and tetrabutylphosphonium bromide (TBPB). These materials were characterized by Fourier transform infrared spectroscopy (FTIR), Proton Nuclear Magnetic Resonance (1H-NMR), Atomic force microscopy (AFM), Tensile strength analysis, Field emission scanning electron microscopy (FESEM), Thermogravimetric analysis (TGA), Differential scanning calorimetry (DSC). The PILs CO2 sorption capacity were gravimetrically assessed in a Magnetic Suspension Balance (MSB). It was found that the ionic liquids cation influences in the compounds properties as well as in the CO2 sorption. The best result for CO2 sorption (123 mgCO2/g at 30 bar) was obtained for the PIL (PUPT-TBA). The higher CO2 sorption in PUPT-TBA is probably linked to the fact that the tetraalkylammonium cation having a higher positive density charge can have a stronger interaction with CO2, while the imidazolium charge is delocalized. The comparative CO2 sorption values of the PUPT-TBA with different ionic liquids showed that this material has greater capacity for capturing CO2 when compared to the ILs even at higher temperature. This behavior highlights the importance of this study, as the poly (urethane) based PILs are cheap and versatile materials.

Keywords : capture, CO2, ionic liquids, ionic poly(urethane)
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