Synthesis of PIL membranes for CO_2 separation

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Carbon dioxide (CO_2) can be commonly found in natural gas streams, biogas, flue gas and product of coal gasification[1]. The presence of CO_2 and other acid gases reduce the thermal efficiency and make the gas streams become acidic and corrosive, which in turn reduces the possibilities of gas compression and the transport within the transportation systems[2]. Membrane separation is a promising technology for CO_2 capture due to its energy efficiency, simple process design, low cost and environmentally friendly[3]. Recently, ionic liquids (ILs) have attracted great attention for their potential as alternative media for CO_2 separation due to their unique properties[4]. It has been extensively investigated the immobilization of ILs in membranes via combine the advantages of membranes and ILs and overcome their disadvantages for CO_2 capture [2]. According to previous investigations, imidazole-based ILs have excellent affinity to CO_2. Poly(vinylimidazole) was considered as the promising precursor candidate of poly(IL) membrane used for CO_2 separation. Poly(vinylimidazole) is a brittle polymer, therefore butyl acrylate, to provide softness, was copolymerized with N-vinylimidazole to prepare membranes with exceptional mechanical property. The as-prepared poly(vinylimidazole-co-butylacrylate) was cross linked by 1, 6-dibromohextane to form membranes, while IL was formed. What is more, free IL was introduced in the curing process to prepare hybrid composite membranes to increase the permeability of CO_2 of the membrane [5]. Different ratio of N-vinylimidazole and butyl acrylate and amount of cross linker were investigated to get membranes with relatively high CO_2 separation performance.

[1] Y. Zhang, J. Sunarso, S. Liu, R. Wang, Current status and development of membranes for CO2/CH4 separation: A review, Int. J. Greenh. Gas Control. 12 (2013) 84–107.
[2] J. Deng, L. Bai, S. Zeng, X. Zhang, Y. Nie, L. Deng, S. Zhang, Ether-functionalized ionic liquid based composite membranes for carbon dioxide separation, RSC Adv. 6 (2016) 45184–45192.
[3] S. Rafiq, L. Deng, M.-B. Hägg, Role of Facilitated Transport Membranes and Composite Membranes for Efficient CO 2 Capture - A Review, ChemBioEng Rev. 3 (2016) 68–85.
[4] S.C. Lu, A.L. Khan, I.F.J. Vankelecom, Polysulfone-ionic liquid based membranes for CO2/N2 separation with tunable porous surface features, J. Memb. Sci. 518 (2016) 10–20.
[5] E. B. Jason, D. L. Gin, R. D. Noble, Effect of Anion on Gas Separation Performance of Polymer−Room-Temperature Ionic Liquid Composite Membranes, Industrial & Engineering Chemistry Research, (2008) 9919-9924