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Use of organic ionic plastic crystal (OIPC) membranes for selective permeation of CO_2 over nitrogen

Jonathan Lane McDonald
Deakin University, Australia

CO_2 is a major contributor to anthropogenic climate change. Because it will take decades to replace existing coal-fired power generation infrastructure, post-combustion capture is important to reduce carbon emissions while the transition to more sustainable power generation is underway. At Deakin University, I use organic ionic plastic crystal (OIPC) membranes to separate CO_2 from nitrogen. A plastic crystal has multiple solid phases, including a "normal", highly regular crystalline phase. As a plastic crystal is heated, the associated volumetric expansion allows varying degrees of motion or rotation of lattice constituents and functional groups. While this motion is taking place, the long range order of the crystal is preserved. These properties confer high diffusion rates even in solid phases. An OIPC has the same properties, but consists entirely of ions. This makes them non-volatile, more thermally stable, and highly tunable as appropriate ion selection can ideally be done on an application-specific basis. The high diffusion rates and correlation between diffusion rates and the degree of rotation/mobility of the OIPC lattice has been well studied in the context of lithium diffusion through OIPC solid-state electrolytes. In this work, the OIPCs $P1224PF_6$ and $C_2mpyrBF_4$ were supported in nanofibrous PVDF and the ideal selectivities for the CO_2/N_2 gas pair were measured at 35°C. The results were separation factors of 29 and 33, respectively, which are competitive with conventional polymers and supported ionic liquid membranes.

Biography

Jonathan Lane McDonald completed a Bachelor of Science in Chemistry at the University of South Alabama. He then graduated with a Master of Science in Environmental Toxicology from the same school before beginning his PhD in Materials Engineering at Deakin University in Melbourne Australia.

jlmcdona@deakin.edu.au

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