Sieving oxygen isotopes through one-, two- and three-dimensional porous materials

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The separation of isotope molecules with similar size, shape and nearly identical chemical properties is an important technological challenge. However, these isotope gases pose crucial and inevitable economic and scientific opportunities and there is a need to separate these molecules selectively at low concentrations in air. Likewise, oxygen isotope molecules are important candidate for medical diagnostic application and isotope labeling, but low productivity and large energy costs involved in the present fractional distillation based separation of these molecules hinder their relevant applications. In recent years, Quantum molecular sieving has aroused great interest in the area of low temperature adsorption separation of isotopes. However, it is restricted only to lighter isotopes such as H_2/D_2, H_2/T_2etc.[1-3]

Here, we are reporting highly selective low temperature adsorption based molecular sieving for heavier oxygen isotope ($^{18}O_2$) separation using 1-D (oxidized single walled carbon nanotube; ox-SWCNT), 2-D (Activated carbon fibers; ACFs, carbide derived carbon; CDC) and 3-D (zeolites) porous adsorbent materials. The selectivity (S = $^{18}O_2/^{16}O_2$) for heavier oxygen isotope $^{18}O_2$ over lighter oxygen isotope $^{16}O_2$ shows high dependence on the pore size, shape and temperature of the adsorbent. The excellent selectivity and tunable quantum molecular sieving effect in the porous materials will open a promising avenue for the $^{18}O_2$ isotope harvest for advancements in biomedical applications particularly Positron Emission Tomography (PET) imaging technique.

Reference(s)

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