Hyunchul Oh, J Chromatogr Sep Tech 2017, 8:7(Suppl)
DOI: 10.4172/2157-7064-C1-037

Quantum sieving for separation of hydrogen isotopes using MOFs

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Separating gaseous mixtures that consist of very similar particles (such as mixture of light gas isotopes) is one of the challenges in modern separation technology. Especially hydrogen isotoepe separation is a difficult task since its size, shape and thermodynamic properties share each other. Hydrogen isotope mixtures can be effectively separated either by confinement in small pores [i.e., "kinetic quantum sieving" (KQS)] or by strong adsorption sites [i.e., "chemical affinity quantum sieving" (CAQS)] on porous materials. MOFs are excellent candidates for study of these quantum effects, due to their well-defined, tunable pore structures and the potential to introduce strong adsorption sites directly into the framework structure. In this talk, the feasibility of MOFs as isotope sieves is outlined through the experimental results obtained by low-pressure high-resolution isotherms and cryogenic thermal desorption spectroscopy (TDS) directly on isotope mixtures. Firstly, different porous frameworks have been investigated to establish a fundamental correlation between selectivity and pore diameter at optimized operating conditions. Afterwards, two strategies for satisfying industrial requirements are introduced. Firstly, the operating pressure is increased by introducing cryogenically flexible pore aperture. Secondly, the operating temperature is increased by utilizing the different chemical affinity of isotopes on strong adsorption sites. Finally, the deuterium enrichment process is experimentally demonstrated by applying a temperature swing adsorption process.

Biography

Hyunchul OH is an Assistant Professor in the Department of Energy Engineering at GNTECH. He obtained his PhD at Max Planck Institute (MPI), Germany. He worked as a postdoctoral research fellow and associated research fellow at MPI-IS and the KISTEP(Korea Institute of S&T Evaluation & Planning). His current research interests are gas storage and light gas isotope separation using microporous materials.

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