

Gas Diffusion in Microporous Membranes and Related Systems by Advanced NMR Techniques

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Carbon molecular sieve (CMS) membranes and nanotube systems are of large interest due to potential applications in gas separations. The former materials are microporous membranes fabricated from pyrolysis of polymeric precursors. They are promising systems for energy-efficient separations of light gases under conditions of normal, i.e. Fickian diffusion. Nanotube systems can potentially be used for gas separations under the conditions of anomalous, single-file diffusion. In this seminar I will discuss the results of our studies of gas diffusion in both types of materials using a unique pulsed field gradient (PFG) NMR method that combines the advantages of using large magnetic field gradients and high magnetic field. This enables obtaining reliable diffusion data even under the conditions of small sorbate diffusivities and short NMR relaxation times expected for tight confinement in micropores. As a result, PFG NMR studies could be performed for normal and single-file diffusion on micrometer and submicrometer length scales of displacements under well-defined, uniform sorption loading and temperature conditions. The results of these studies will be presented and discussed.