

HIGHLIGHTS IN ENERGY RESEARCH

21.11.2019, 16:00 - 17:00, EPFL Valais, 4th floor, TSEUZIER room

Vapor-phase Synthesis and Modification of Metal-Organic Framework Membranes

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Metal-organic frameworks (MOFs) hold promise as separation membranes due to their structural diversity stemming from theoretically unlimited metal/organic linker combinations enabled by direct synthesis and by post-synthetic modifications. Although relatively rapid progress for highly selective MOF membranes has been achieved, commercialization is still limited by the high processing costs and limited scalability associated with solvothermal processing. The recent introduction of solvent-free synthesis method for ZIF membranes, by combining atomic layer deposition and ligand vapor treatment, called ligand induced permselectivation (LIPS), holds promise for overcoming this obstacle. Systematic characterization of the microstructure of LIPS-ZIF-8 membranes and their permeation properties under industrially relevant conditions (elevated feed pressure, absence of any sweep gas in permeate) will be discussed. Moreover, the facile modification of ZIF-8 membranes made by LIPS (LIPS-ZIF-8) through a vapor phase ligand treatment (VPLT) method to tune their separation performance towards smaller molecules will be presented. VPLT of a MOF membrane is shown to allow for systematic regulation of permeation properties. Of particular interest is the observed stable O₂/N₂ selective performance, which compares favorably with that of optimized gas separation polymeric membranes. VPLT is a versatile method, applicable to thin and thick membranes made by different methods, and when combined with LIPS, it extends the applicability of all-vapor MOF membrane processing to unprecedented levels of tunability for specific applications without sacrificing scalable processability.