SURFACE-ENHANCED SEPARATION PERFORMANCE OF POROUS INORGANIC MEMBRANES FOR BIOFUEL CONVERSION APPLICATIONS

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This presentation will introduce a new class of porous inorganic-based membranes, which provide high perm-selective flux by exploiting unique separation mechanisms induced by superhydrophobic or superhydrophilic surface interactions and “confined capillary condensation”. These high-performance architectured surface selective (HiPAS) membranes were originally developed for the purpose of bio-oil/biofuel processing to achieve selective separations at higher flux relative to size selective porous membranes (e.g., inorganic zeolite-based membranes) and better high-temperature tolerance than polymer membranes (> 250°C) for hot vapor processing. Due to surface-enhanced separation selectivity, HiPAS membranes have the potential to enable large-flux separations by increasing membrane pore size from sub-nanometer pores to mesopores (2-50 nm) for vapor phase or micron-scale pores for liquid phase separations. In this paper, we describe an innovative membrane concept and a materials synthesis strategy to fabricate HiPAS membranes, and demonstrate selective permeation in both vapor and liquid phase applications. High permeability and selectivity were demonstrated using surrogate mixtures, such as ethanol-water, toluene-water, and toluene-phenol-water. The overall membrane evaluation results show promise for the future processing of both raw and upgraded biomass pyrolysis product vapors and condensed liquid bio-oil intermediates.