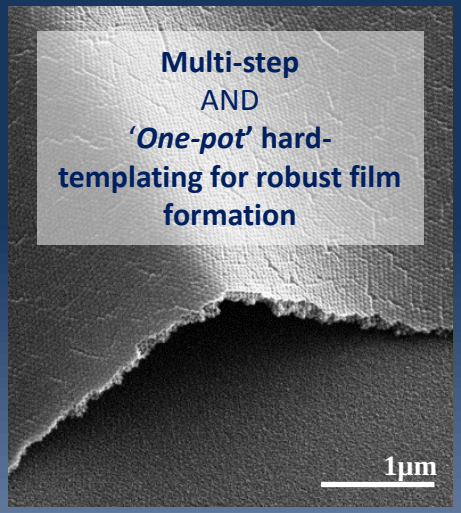
Fundamental Insight into the Hierarchical Engineering of Nanoparticulate and Templated Porous Films for Molecular Separations

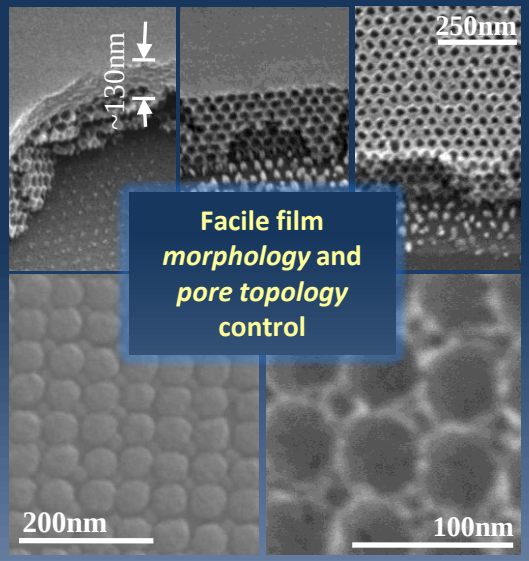
Mark A. Snyder, *Department of Chemical Engineering, Lehigh University, Bethlehem, PA 18015*

Motivation: The ability to synthesize ultra-thin porous inorganic films with tunable, highly ordered pore topologies holds implications spanning molecular selectivity and flux as it relates to membrane-based gas, vapor, and liquid separations to efficient electrode technologies in solar cells.

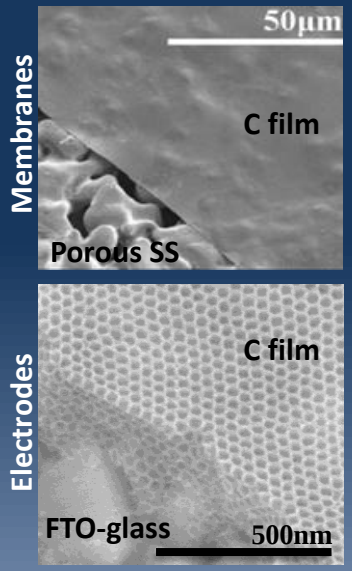
Goal: Establish a facile strategy for simultaneously tuning pore size and film thickness of porous inorganic films, the latter to the level of just tens to hundreds of nanometers by decoupling template assembly from chemistries of film formation.



Versatile C sources:
Phenol-formaldehyde, resorcinol, furfuryl alcohol, sucrose, glucose,…



Robust substrate transfer



Outcomes:

- Realization of *defect-free, mechanically flexible* porous carbon and scaffolded zeolite films with ordered mesopore and mesopore-supported microporous thin films scalable to *tens of nanometers in thickness*
- Novel, *multi-modal pore topologies* realized via facile convective co-assembly of *binary nanoparticle solutions*
- Robust *film transfer among substrates* (e.g., porous supports, conductive glass), bridging processing & applications
- Decoupling of template and film formation enabling *versatility of carbon source* as an additional *independent handle for tuning film properties* (e.g., molecular sieving, conductivity, mechanical robustness, etc.)
- Realization of '*one-pot' hard-templating* of three-dimensionally ordered mesoporous powders and thin films