

Visualization and Control of Transport and Flow Through Mesoporous and Crowded Environments

Opportunity

- Understand how to control transport and flow in mesoporous materials
 - Examples: gas and oil extraction, lipids, membranes, nanofluidics
- Visualize transport through diffusion-limited environments i.e. very low Reynolds numbers
- Develop new materials with tunable environments to enhance or minimize transport and flow
- Understand mass transport rates at the single pore level
- Develop methods capable of resolving transport at the level of a single pore

Meso Challenge

- Systems are typically dynamic
- Multiporous membranes with inhomogeneous pores
- “Functional” mesoporous systems
- How can we identify, locate, and characterize transport through mesoporous environments
- Can we optimize materials to sense local environment

Approach

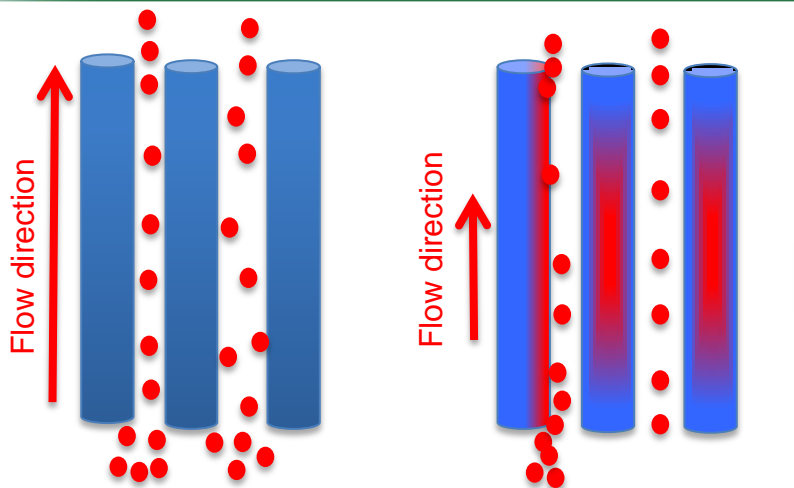
- New functional optical probes
 - Nanotubes with tunable optical and physical properties
 - Soft functionalization can alter surface charge
- 1D fluorophores can align in shear flow even at low Reynolds numbers, instantaneous flow field
- High speed near infrared video microscopy in the water and biological window
- 3D particle tracking and single-photon counting for investigating correlated motions

Impact

- Identifying and understanding what drives mesoporous flow and transport
- This multiple-scale and multiple-environment approach of synthesis, and measurements will provide a new platform for characterizing flow and transport in mesoporous systems
- Direct applications in oil recovery, drug delivery, nanofluidic energy conversion, etc.

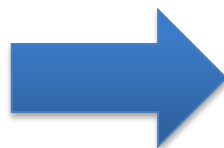


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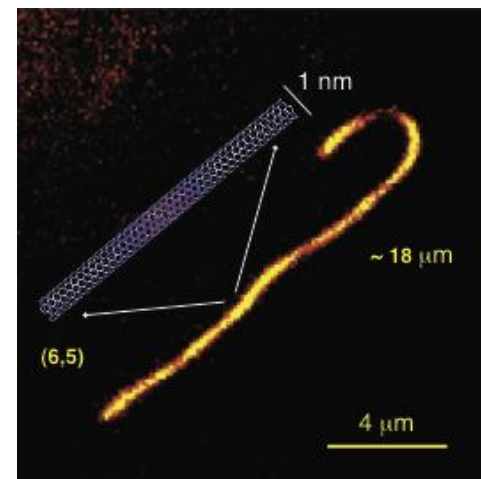


Visualization of transport and flow

Tunability of flow/transport



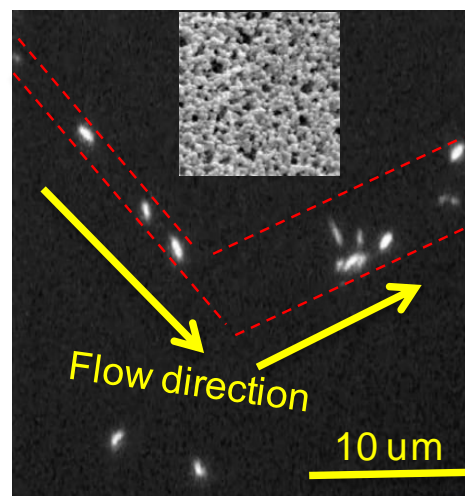
New optical probes with tunable properties and interactions



Identification, visualization, and characterization of transport and flow through mesoporous media.

Requires new functional optical probes which respond to flow field.

Providing an understanding of transport rates at the mesoscale.



Flow in nano-pores with tunable environments.



U.S. DEPARTMENT OF ENERGY

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