UCDAVIS
MATERIALS SCIENCE AND ENGINEERING

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Molecular transport in carbon nanotube porins

Controlling ion and water transport on a molecular scale is important for applications ranging from industrial water treatment, to membrane separations, to bioelectronic interface design. Living systems move ions and small molecules across biological membranes using protein pores that rely on nanoscale confinement effects to achieve efficient and exquisitely-selective transport. I will show that carbon nanotube porins—pore channels formed by ultra-short carbon nanotubes assembled in a lipid membrane—can exploit similar physical principles to transport water, protons, and small ions with efficiency that rivals and sometimes exceeds that of biological channels. I will discuss the role of molecular confinement and slip flow in these pores and show how it can enhance water and proton transport efficiency and influence the mechanisms of ion selectivity in these pores. Overall, carbon nanotube porins represent simple and versatile biomimetic membrane pores that are ideal for building the next generation of separation technologies and biointerfaces.

Short Bio: Alex Noy is a Senior Research Scientist at LLNL. He joined the Lab in 1998 as its first E.O. Lawrence Fellow after getting his BA in Chemistry from Moscow University in his native Russia and a Ph.D. in Physical Chemistry from Harvard University under the direction of Charles Lieber. His research group works at the intersection of nanoscience, biophysics and biomaterials fields. The current research portfolio in the Noy group centers on carbon nanotube nanofluidics, where they develop carbon nanotube porins and membranes to study transport in highly-confined environment and develop new separation technologies. Other projects in the group work on novel biolectronic devices that incorporate functional biological and biomimetic components to create seamless bidirectional neural interfaces and use high-speed atomic force microscopy to image biological processes in-situ in real time. Since 2005, Noy also has served as an adjunct faculty at UC Merced where he currently holds the rank of the Adjunct Full Professor.