EPFL Valais, ChE 602 Seminar, 15.09.2016

Title: Efficient Mass Transport Under Continuous and Discontinuous Graphitic Confinement

Abstract:
Efficient mass transport inside and across nanoscale graphitic surfaces such as carbon nanotubes and graphene, respectively, forms the basis of aqueous “carbon nanofluidic” phenomena for which there are numerous applications in energy and clean technologies. These unique phenomena of nanoscale mass transport has been actively pioneered, and still many questions remain unanswered such as “how fast is fast?” In this talk, we will first review briefly the nanofluidics of fast water transport in carbon nanotubes and across graphene. Following, we will present our story of water transport measured under these graphitic nanoconfinements. A new scaling for comparing flow enhancement factors in carbon nanotubes will be proposed and discussed. This scaling can reconcile the apparent disagreement between simulations and experiments about how fast water can flow in carbon nanotubes.

Nearly frictionless flows established in carbon nanotubes lead to a question of ultimate permeation speed if one recognizes that having a friction-minimized pore could be equivalent to having no pore wall but only openings. To address this question, graphene serves as a material of choice for its great mechanical strength. We designed and manufactured a porous graphene membrane by direct physical perforation (focused ion beam milling) of freestanding double-layer graphene. When driven by pressure, the values of water permeance across this 2D membrane exceed that of any membrane material of the similar pore sizes and approach Sampson’s formula – a theoretical prediction of the ultimate rate of a pressurized flow across a 2D disk

Bio:
Prof. Hyung Gyu Park is an Associate Professor in the Department of Mechanical and Process Engineering at the Swiss Federal Institute of Technology (ETH) in Zurich, where he leads the laboratory of Nanoscience for Energy Technology and Sustainability (www.nets.ethz.ch). He received his PhD in Mechanical Engineering from the University of California, Berkeley, with pioneering research on nanoscale mass transport in carbon nanotubes in collaboration with Lawrence Livermore National Laboratory. He joined ETH Zurich in 2009 as a tenure-track Assistant Professor and has been active in research topics including carbon nanomaterials syntheses, surface enhanced Raman spectroscopy, energy harvesting and storage, and carbon nanofluidics.