Séminaire général de physique

Fluidics and mechanics at the nanoscales: fast and curious

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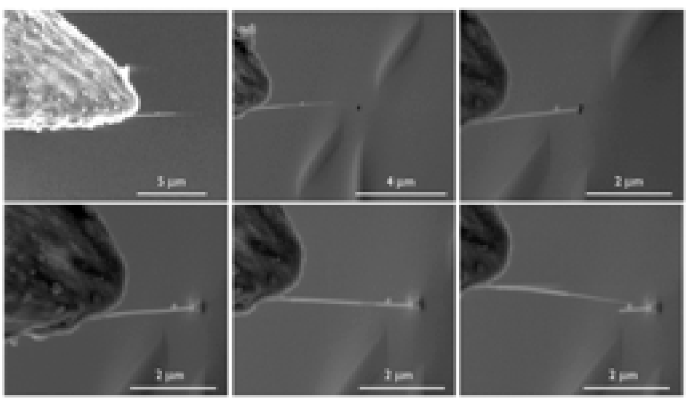
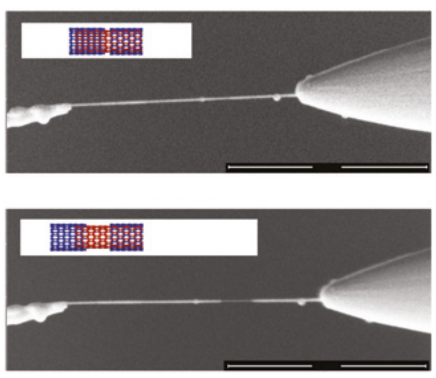
(café-croissants à partir de 9h40)

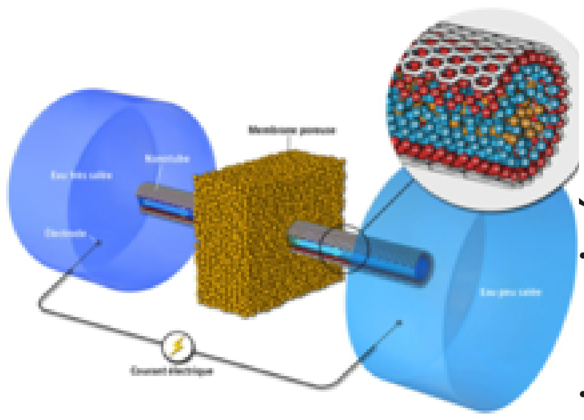
Fluid transport at the nanoscales is one of the remaining virgin territory in fluid dynamics, in spite of hydrodynamics being a very old and established domain. Over the last years, a number of striking phenomena have been unveiled, such as super-fast flows in carbon nanotubes, hydrodynamic slippage, fluidic diodes, nanobubble superstability, … and many of them are still awaiting an explanation. A major challenge to adress the fundamental properties at the nanoscales lies in building distinct and well-controlled nanosystems, amenable to the systematic exploration of their properties. To this end, we have developed new methods based on the manipulation of nano-objects, displacing, cutting, and glueing these elementary building blocks. This allows us to fabricate original fluidic and mechanical systems involving single nanotubes.

I will first discuss fluidic transport inside single nanotubes. Putting osmotic transport and its fundamental origins into perspective, I will show how to harvest this powerful mechanism beyond the classical van't Hoff law. Experiments of osmotic transport across boron-nitride show unprecedented energy conversion from salt concentration gradients. This points to new avenues in the field of osmotic energy harvesting from salinity gradient.

Then I will explore the friction properties between the layers of boron-nitride and carbon nanotubes in a christmas-cracker geometry, in which a multiwalled nanotube is torn apart between a nanomanipulator and a quartz-tuning-fork-based atomic force microscope. We measure a huge viscous-like interlayer friction for BNNTs, whereas for the CNTs the sliding friction vanishes within experimental uncertainty. I will discuss possible mechanisms at the origin of the contrasting behaviors of CNTs and BNNTs.







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