Theoretical insights of electrolyte transport in nanopores

Manoel Manghi\textsuperscript{a,}\textsuperscript{*}, John Palmeri,\textsuperscript{b} et B. Loubet\textsuperscript{a}

\textsuperscript{a.} Laboratoire de Physique Théorique, IRSAMC, Université de Toulouse, CNRS, UPS, Toulouse.

\textsuperscript{b.} Laboratoire Charles Coulomb, UMR 5221 CNRS-Université de Montpellier, Montpellier.

\textsuperscript{*} manghi@irsamc.ups-tlse.fr

Fundamental understanding of ionic transport at the nanoscale is essential for developing biosensors based on nanopore technology and new generation high-performance nanofiltration membranes for separation and purification applications.

After a general introduction on the theoretical modeling of ionic transport in nanopores, we present a mesoscopic theoretical approach for the electrolyte conductivity inside nanopores. The model considers explicitly ion advection by electro-osmotic flow, possible flow slip at the pore surface (when the pore is hydrophobic) \cite{1}, dielectric exclusion of the ions \cite{2}, hard core repulsion between ions \cite{3}, and surface charge regulation \cite{4}. Various regimes where the conductivity has a relatively simple analytical expression are identified.

The theory is then compared to experimental measurements of ionic transport through single putatively neutral hydrophobic nanopores and with a well controlled cylindrical geometry \cite{1} and through single wall carbon nanotubes \cite{5}. We focus on the dependence of the nanopore conductance with the reservoir ionic concentration, showing various behaviours depending on the experimental conditions.


