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results show that these psychoactive drugs cause severe phenotypic effects on C. elegans when used in combination, but not individually. Additionally, the WormPharma 

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Separation of Peptides and Interaction with Forward Osmosis Biomimetic Membranes: A Solution Diffusion Model

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Recently, a membrane based technique, forward osmosis (FO), has gained interest with respect to the separation and purification of biomolecules. Forward osmosis relies on concentration gradients to draw water across the membrane and is as such a gentle technique compared to the traditional pressure driven membrane processes. The challenge within FO is to operate at a high water flux while maintaining a high rejection and low reverse flux of salt that may otherwise interfere with the biomolecules. By adding water-transporting aquaporin protein channels to the membrane matrix to create biomimetic membranes, selective transport of water is possible. These kinds of membranes could as such be ideal for separation of biomolecules.

In this study, a biomimetic forward osmosis membrane was tested for the separation of two peptides (416.48 Da and 691.71 Da). The membrane was found to exhibit high, but not complete, rejection rates of both peptides (>98%). It is interesting that even relatively large molecules are able to pass the otherwise dense active layer of the forward osmosis membrane. Therefore, to further understand the transport mechanisms underlying the filtration process, a custom made cell was constructed and used to model the process with filtration models. It was found that the filtration process could be modeled using the solution diffusion approach, with the diffusion coefficient being related to the radius of gyration of the peptides.

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Translocation of Short Polymers through a Sieve

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By employing this platform with only one or a few open CNTs, we observed ionic current and even in what ions are actually carrying the current; moreover, we used first-principle simulations to show that cation-CNT interactions are unique of CNT pores. To understand and quantify electro-osmotic flow in CNT pores (which has been proposed as the transport mode responsible for the giant ionic currents in CNTs), we investigated translocation of neutral molecules in a single CNT nanochannel with the resistive pulse technique. Furthermore, we used first-principle simulations to show that cation-CNT interactions may explain the origin of this electro-osmotic flow. Implications of our findings on the physics of electric-field-driven ionic and molecular transport in CNTs will be presented here.

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Anomalous Ionic Conductance in Carbon Nanotube Nanochannels

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Simulations and experimental studies have reported an unusually high ionic conductance in carbon nanotube (CNT) nanochannels. The origin of this phenomenon is, however, poorly-understood: literature reports often disagree in the magnitude of different transport mode contributions to the measured ionic current and even in what ions are actually carrying the current; moreover, results obtained with single pore measurements differ frequently from those with membranes containing billions of open CNT channels, i.e. the average CNT behavior. Toward shedding light on these phenomena, we fabricated a novel platform having vertically-aligned sub-5nm carbon nanotubes as nanofluidic channels, the number of which can be controlled from one to billions. By employing this platform with only one or a few open CNTs, we observed giant ionic currents in CNT channels and a power-law increase of conductance with KCl concentration (G ∝ c^α, n=0.1-0.4), a dependence that seems to be unique of CNT pores. To understand and quantify electro-osmotic flow in CNT pores (which has been proposed as the transport mode responsible for the giant ionic currents in CNTs), we investigated translocation of neutral molecules in a single CNT nanochannel with the resistive pulse technique. Furthermore, we used first-principle simulations to show that cation-CNT interactions may explain the origin of this electro-osmotic flow. Implications of our findings on the physics of electric-field-driven ionic and molecular transport in CNTs will be presented here.