Advanced Bioinspired Membranes from Biological Ion Channel Confined into Polymeric Cylindrical Nanopores for Enhanced Filtration

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Abstract

Recent advances in membranes allow their use in fields as diverse as food and agriculture, industrial water treatment, potable water production and biotechnology. Among the newly developed technologies, nanofiltration for liquids and more particularly for desalination of seawater or saline aquifers is the most recent one. However, current solid-state membranes are limited, which calls for the development of novel formulations for new membranes, which can offer both high permeability (ion and water flux) and ion differentiation (selectivity) that are usually considered antagonist features. We report on the strategic development of hybrid nanoporous membranes made of a solid-state track-etched polymeric thin film and graphene oxide (or functionalized graphene) as supports in which biological ion channel such as Gramicidin A and ion selective binding peptide motifs are confined, respectively. These bioinspired membranes are attracting widespread attention as they are expected to offer several advantages including mechanical robustness, scalable, controlled nanopore dimension and shape, modifiable surface for desired function and energy-efficiency, for water sustainability. The permeability and selective ion transport will be evaluated via ion diffusion kinetics and nanofiltration while gaining insights into the role of key performance parameters including track-etch pore size, surface chemistry, ion binding through nanochannels for water purification. The proposed activity positively impacts the environment by integrating ecofriendly materials design, development and deployment.