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НАЗВАНИЕ ТЕЗИСА ДОКЛАДА

SMART MEMBRANE BASED ON 2D-CRYSTALS AND POLYELECTROLYTES WITH PROGRAMMABLE IONIC CHANNELS

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At present work, the new generation of membrane for tuning permeability was demonstrated. A two-dimensional self-assembled composite of graphene oxide and polyethyleneimine was formed as a network of ionic channels. This allows the synthesis of the membranes with programmable permeability and selectivity.

Adaptive for various chemical species is one of the essential mechanisms of biological membranes. Suggested platform based on the class of dynamic polyelectrolytes (PE), combined with two-dimensional (2D) materials, opening multiply opportunities for applications. The 2D now materials cover various properties: from most conductive to insulating, from hydrophilic to hydrophobic. However, only one atom (unit cell) thick, so they are very flexible and easy to modify in terms of their permittivity towards molecules and ions. Stimuli-responsive macromolecules is a vast class of natural and synthetic polymers, macro-chains containing charged groups. Electrostatically bonded positively and negatively charged PE form dynamic networks that can be reversibly switched between porous or dense structures or release of small molecules (water, ions). Such unique phase transition can be achieved in a single polymer molecule or a one-pair with nanometre precision.

Here the new platform for creating novel membranes with predetermined functionality or even multiple functionalities was suggested. Ionic permeability through the membranes was studied. The ion concentration was measured by inductively coupled plasma optical emission spectroscopy analysis 24 h after the permeability test. It was shown that membranes were much more permeability for K^+ rather than other alkali ions. The potentiometric titration was done to explain the difference in the permeability of K^+ and other ions and the cumulative effect of ion permeability. The proposed model is highly phenomenological, and thus it is complicated to provide a quantitative description for it. The fundamental mechanism that opens the ionic channels for hydrated ions is replacing a fraction of protons in the interlayer PE with K^+ ions. The K^+/H^+ exchange can be treated as a stochastic process of competition between protons and potassium ions for the available sites on self-assembled membranes.

Membranes are an essential part of the live nature around us. Meticulously constructed objects of often few nanometres in size are usually capable of performing multiple and complex functions. Currently, the present technology is remarkably naïve in comparison with the abilities of biological membranes. Replacing a single, elementary function of such naturally occurring membranes often requires the machinery of dramatic complexity and size. For instance, the represented membrane could apply for water purification, which is still not as efficient as cell membranes' abilities to support large gradients of pH and ion concentrations in our body.

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