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Preparation of membranes from two dimensional materials using bombardment by particles

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Technology Summary

Here we describe the method for membranes preparation from two dimensional (2D) materials such as graphene, transition metal dichalcogenides and others. Such membranes can be used for variety of separations and purification applications including desalination and gas separations. Proposed membranes have distinct advantages over current state-of-the art. For example, being atomically thin, membranes require much less energy input to perform separation compared to currently used membranes, for example reverse osmosis membranes for desalination application.

We propose to use energetic particles with energies from eV to hundreds GeV for fabrication of nanopores in the material. Various energies and particles sizes such as electrons, neutrons, ions and ion clusters can be used for nanopores fabrication. We provide example of graphene membrane fabrication and defect introduction by electrons and ions. Resulted defects were too small for ions (K+,Na, Cs+, Cl-) penetration, whereas it allowed gas flux though the prepared membrane.

Unlike other approaches for membrane production, our proposed method to introduce nanopores to 2D materials has number of advantages such as a) easy control of the pores density; b) controllable pore size by irradiation angle and particle energy.

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