[Researchers simulate simple logic for nanofluidic computing]

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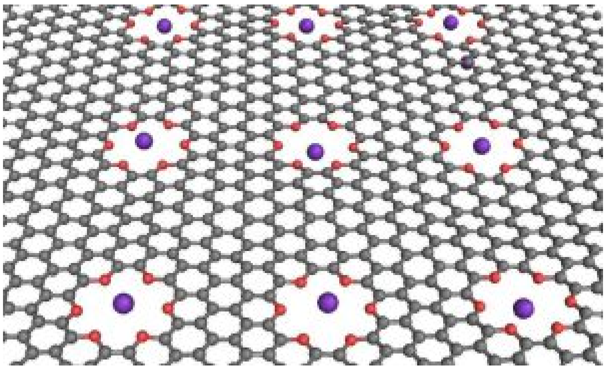

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NIST's ion-based transistor and logic operations are simpler in concept than earlier proposals. The new simulations show that a special film immersed in liquid can act like a solid silicon-based semiconductor.

The NIST molecular dynamics simulations focused on a graphene sheet 5.5 by 6.4 nanometers (nm) in size and with one or more small holes lined with oxygen atoms. These pores resemble crown others electrically neutral circular molecules known to trap metal ions.

In the NIST simulations, the graphene was suspended in water containing potassium chloride, a salt that splits into potassium and sodium ions. The crown ether pores were designed to trap potassium ion, which have a positive charge.

Applying voltages of less than 150 mV across the membrane turns “off” any penetration. Essentially, at low voltages, the membrane is blocked by the trapped ions, while the process of loose ions knocking out the trapped ions is likely suppressed by the electrical barrier. Membrane penetration is switched on at voltages of 300 mV or more. As the voltage increases, the probability of losing trapped ions grows and knockout events become more common, encouraged by the weakening electrical barrier. In this way, the membrane acts like a semiconductor in transporting potassium ions.

More information: Alex Smolyanitsky et al. Aqueous Ion Trapping and Transport in Graphene-Embedded 18-Crown-6 Ether Pores, *ACS Nano* (2018). DOI: 10.1021/acsnano.8b01692