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Gatability of vanadium dioxide single crystal nanobeams and hydrogen doping[1] JIANG WEI, HENG JI, DOUGLAS NATELSON, Rice University — Vanadium dioxide is famous for its dramatic metal insulator transition, exhibiting up to 4 or 5 orders magnitude change in conductivity. It is also known to be nongatable, although in the insulating phase it behaves like a semiconductor with 0.5-0.7 eV energy gap. With no sign of gating effects using conventional dielectric materials, such as SiO_2, Al_2O_3 and HfO_2, ionic liquids were used as the gating medium. Ionic liquids form electric double layers (EDL) and could possibly exert an electric field as high as 10^9V/m on the interface of ionic liquid and single-crystal vanadium dioxide nanobeam. No gating effect was observed in the vanadium dioxide device. On the other hand, we found that under positive gate voltage the hydrogen ions originating from trace amounts of water diffuse into the vanadium dioxide crystal, acting as dopants. By controlling the gate voltage and temperature, the insulating phase's conductivity can be reversibly increased up to 2-3 orders magnitude by this process.

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