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Hydrogen stabilization of metallic VO2 in single-crystal nanobeams[1] JIANG WEI, HENG JI, WENHUA GUO, ANDRIY NEVIDOMSKYY, DOUGLAS NATELSON, Rice University — Vanadium dioxide (VO_2) is a strongly correlated material with a metal-insulator transition at 67^oC from a high temperature, rutile metal to a lower symmetry insulating state. Substitutional doping can alter the properties of VO_2, but is irreversible. Using individual microcrystals and nanobeams, we show that spillover may dope VO_2 reversibly with atomic hydrogen. Raman and optical microscopy show a stabilized metallic state, consistent with single-crystal electron diffraction and scanning electron microscopy that demonstrate a post-hydrogenation structure similar to the rutile state. Electronic transport shows that the energy band gap of insulating phase can be reversibly tuned towards the metallic phase upon different hydrogenation conditions and the metallic state may be stabilized down to cryogenic temperatures. Electronic structure calculations agree that a hydrogen-containing distorted rutile structure is energetically favored over the monoclinic state.

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Jiang Wei
Rice University

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