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The metal-insulator triple point in vanadium dioxide[1]

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The metal-insulator transition (MIT) in vanadium dioxide is a candidate for optical and electrical switching applications. However, being a first-order solid-state phase transition makes it challenging to study reproducibly in any detail. The combination of the change in unit cell shape, symmetry reduction, long range of elastic distortion, and latent heat leads to domain structure, hysteresis, and cracking of even the highest quality samples. At the MIT two stable insulating phases (M1 and M2) occur in addition to the metallic phase (R), but their phase stability diagram was poorly known. To establish it precisely we studied single-crystal nanobeams of VO_2 in a purpose-built nanomechanical strain apparatus. We were able to measure the transition temperature accurately to be 65.0 +- 0.1 ^{o}C, to determine the phase boundary slopes, and to detect the intermediate metastable triclinic (T) phase where it is metastable towards M2. We were surprised to find that the transition occurs precisely at the solid-state triple point of the metallic and two insulating phases, a fact that is not explained by existing theories. See J.H. Park et al, Nature 500, 431-4 (August 2013), doi:10.1038/nature12425.

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