Abstract for an Invited Paper
for the MAR10 Meeting of
The American Physical Society

New aspects of the metal-insulator transition in vanadium dioxide nanobeams[1]

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The fundamental properties of the famous metal-insulator phase transition in vanadium dioxide are obscured in traditional samples by domain structure. In contrast, single-crystal nanobeams of the material can be prepared in such a way that the frustration is absent, and the stress is zero or almost uniform, even while the transition is taking place. Studying nanobeams using a combination of transport and optical methods has allowed us to obtain a number of new results, including the following. First, the uniform metallic phase can be dramatically supercooled. Second, the so-called M2 insulating phase shows a temperature-independent resistivity at the transition, implicating electron-electron interactions in the controlling mechanism. Third, the M1 and M2 insulating phases have the same thermal electronic gap. Fourth, we establish a new phase diagram of the material as a function of stress along the rutile c-axis which helps to explain a number of recent experiments and some anomalies in the older literature. Work done in collaboration with Jiang Wei, Jae Park, Vinny Roma, Andrew Jones, Sam Berweger, and Markus Raschke.

[1]Supported by Army Research Office contract 56073-PH and DoE BES contract DE-SC0002197