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Metal-insulator transition and nanoscale phase separation in a hole-doped surface reconstruction[1] DANIEL MULUGETA, The University of Tennessee, PAUL SNIJDERS, Oak Ridge National Laboratory, HANNO WEITERING, The University of Tennessee — Doping, the deliberate introduction of impurities to alter electronic or magnetic properties, has been a tremendously successful method to study and understand systems with multiple competing interactions, as reflected in both the widespread use of doped semiconductors and in the large number of emergent electronic phases in doping-dependent phase diagrams of e.g. complex oxides. In low dimensional systems, however, the perturbation to the crystal lattice by the dopant atoms can overwhelm a delicate balance of interactions in e.g. a ground state with coexisting phases. Here we introduce a modulation doping technique used to dope holes in a surface reconstruction of Sn on Si(111). Using variable and low temperature scanning tunneling microscopy and spectroscopy, we observe a doping-induced metal-insulator phase transition that is of a displacive nature, contrasting with the order-disorder nature of other surface phase transitions. Moreover, the transition leads to an intrinsic nanoscale phase coexistence at 5 K never before observed on semiconductor surfaces. Clearly, modulation doping allows us to study the delicate balance of interactions in the phase diagram of low-dimensional electronic surface systems that is otherwise experimentally inaccessible.

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