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Hidden phase in a two-dimensional Sn layer stabilized by modulation hole doping.[1] FANGFEI MING, DANIEL MULUGETA, WEISONG TU, TYLER SMITH, PAOLO VILMERCATI, Univ. of Tennessee, Knoxville, GEUNSEOP LEE, Inha Univ. Korea, YING-TZU HUANG, RENEE DIEHL, Penn State Univ., PAUL SNIJDERS, Oak Ridge National Lab and Univ. of Tennessee, Knoxville, HANNO WEITERING, Univ. of Tennessee, Knoxville and Oak Ridge National Lab — Semiconductor surfaces and ultrathin interfaces exhibit an interesting variety of two-dimensional (2D) quantum matter phases, such as charge density waves, spin density waves, and superconducting condensates. Yet, the electronic properties of these broken symmetry phases are extremely difficult to control due to the inherent difficulty of doping a strictly 2D material without introducing chemical disorder. The solution to this problem would allow access to novel phases of matter, and could open up completely new directions in surface physics and quantum matter research. Here we successfully exploit a modulation doping scheme to uncover, in conjunction with a scanning tunneling microscope tip-assist, a hidden equilibrium phase in a hole-doped bilayer of Sn on Si(111). This new phase is intrinsically phase separated into insulating domains with polar and non-polar symmetries. Its formation involves a spontaneous symmetry breaking process that appears to be electronically driven, notwithstanding the lack of metallicity in this system. This modulation doping approach promises new avenues for exploring competing quantum matter phases on a silicon platform.

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