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Characterizing the electronic ground states of single-layer NbSe2 via STM/STS YI CHEN, MIGUEL UGEDA, AARON BRADLEY, UC Berkeley, YI ZHANG, LBNL, SEITA ONISHI, WEI RUAN, CLAUDIA OJEDA-ARISTIZABAL, UC Berkeley, HYEJIN RYU, LBNL, MARK EDMONDS, HSIN-ZON TSAI, ALEXANDER RISS, UC Berkeley, SUNG-KWAN MO, LBNL, DUNG-HAI LEE, ALEX ZETTL, UC Berkeley, ZAHID HUSSAIN, LBNL, ZHI-XUN SHEN, Stanford University, MICHAEL CROMMIE, UC Berkeley — Layered transition metal dichalcogenides (TMDs) are ideal systems for exploring collective electronic phases such as charge density wave (CDW) order and superconductivity. In bulk NbSe2 the CDW sets in at TCDW = 33K and superconductivity sets in at Tc = 7.2K. Below Tc these electronic states coexist but their microscopic formation mechanisms remain controversial. Here we present an electronic characterization study of a single 2D layer of NbSe2 by means of low temperature scanning tunneling microscopy/spectroscopy (STM/STS), angle-resolved photoemission spectroscopy (ARPES), and electrical transport measurements. We demonstrate that the CDW order remains intact in 2D and exhibits a robust 3 x 3 superlattice. Superconductivity also still occurs but its onset is depressed to 1.6K. Our STS measurements at 5K reveal a CDW gap of Δ = 4 meV at the Fermi energy, which is accessible via STS due to the removal of bands crossing the Fermi surface in the 2D limit. Our observations are consistent with the predicted simplified (compared to bulk) electronic structure of single-layer NbSe2, thus providing new insight into CDW formation and superconductivity in this model strongly-correlated system.

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