Enhanced High-T_c Superconductivity at the Buried FeSe / $SrTiO_3$ interface : Insights from Combined *in situ* transport and ARPES measurements

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The enhanced superconductivity at the interface between FeSe and $SrTiO_3$ has attracted considerable attention owing to its unique nature and enormous enhancement in T_c (70K vs 9K in bulk). However, most studies to date have utilized surface-sensitive spectroscopic measurements, necessitating the use of monolayer films to allow access to the interfacial superconductivity. The effect of additional FeSe layers has on the interfacial Tc, as well as the relationship between the opening of the spectroscopic gap and the electrical transport, remain important open questions. As the extreme air sensitivity of the system precludes traditional *ex situ* transport measurements without the addition of potentially damaging capping layers, we utilize an *in situ* UHV four-point electrical contact probe, together with ARPES, to reveal how the opening of the spectroscopic gap in ARPES relates to the temperature-dependent resistivity. We also show that the apparent reduction in the T_c of thicker films is a spurious effect due to uncoupled parallel conduction channels, and that the T_c of the FeSe / $SrTiO_3$ interface is largely unaffected by additional FeSe layers.