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Quantification of Interfacial Electron-Phonon Coupling from Photoemission Replica Bands in a High-T_c Superconductor

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The observation of replica bands by angle-resolved photoemission spectroscopy enables the study of electron-phonon coupling at low carrier densities, particularly in monolayer FeSe/$SrTiO_3$. Theoretical work suggests that the electrons in the ultra-thin FeSe layer couple to optical phonons in the $SrTiO_3$ substrate that thereby contributes to the enhanced superconducting pairing temperature. So far, the inherent fragility of such single-layer thick materials and the weak intensity of replica features has limited the quantitative evaluation of their nature.

To overcome this challenge, the **PARADIM in-house research team developed a system to transfer the sensitive samples from ultrahigh vacuum directly into an inert environment glovebox for transport to the Advance Light Source for beamline ARPES measurements**. Using this approach, PARADIM scientists were able to observe interfacial replica bands in far greater quantitative detail than had previously been possible. A detailed analysis of the energy splittings and relative peak intensities between the higher-order replicas, as well as other self-energy effects, allowed them to determine that the interfacial electron-phonon coupling in the system corresponds to a value of $\lambda = 0.19 \pm 0.02$, providing valuable insights into the enhancement of superconductivity in monolayer FeSe/$SrTiO_3$. Furthermore, the methodology employed in this work can also serve as a new and **general approach for making more rigorous and quantitative comparisons to theoretical calculations of electron-phonon interactions and coupling constants**.

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