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Study of the Superconductivity Enhancement at FeSe/$SrTiO_3$ Interface from the phonon perspective. SHUYUAN ZHANG, JIAQI GUAN, XUN JIA, BING LIU, WEIHUA WANG, Institute of Physics, Chinese Academy of Sciences (IOP CAS), JIANDI ZHANG, WARD PLUMMER, Louisiana State University (LSU), XUETAO ZHU, JIANDONG GUO, Institute of Physics, Chinese Academy of Sciences (IOP CAS) — The significant role of interfacial coupling in the superconductivity enhancement in FeSe films on $SrTiO_3$ has been widely recognized. But the explicit origination of this coupling is yet to be identified. By surface phonon measurements using high resolution electron energy loss spectroscopy, both FeSe and $SrTiO_3$ phonons were observed and studied. The observation of $SrTiO_3$ surface phonons indicates the electric field generated by Fuchs-Kliewer (F-K) phonon modes of $SrTiO_3$ can penetrate into FeSe films and strongly interact with electrons therein. With increasing FeSe thickness, the penetrating field intensity decays exponentially, which matches well the observed exponential decay of the superconducting gap. The surface Debye temperature (˜250 K) and FeSe phonons do not exhibit difference between films with different thicknesses. Thus FeSe phonons do not participate in the interfacial enhancement of superconductivity. It is unambiguously shown that, besides charge transfer, the $SrTiO_3$ F-K phonon penetrating into FeSe is also essential in the interfacial superconductivity enhancement.

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