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Resonant Phonon Coupling in Epitaxial $La_{1-x}Sr_xMnO_3/SrTiO_3(001)$ Heterostructures YARON SEGAL, C.A.F. VAZ, J.D. HOFFMAN, F.J. WALKER, C.H. AHN, Applied Physics and Center for Research on Interface Structure and Phenomena, Yale University — The rich physical phenomena observed in complex manganites stem from strong electron-electron and electron-phonon correlations, which are at the origin of the strong interplay between charge, spin, and orbital degrees of freedom in these materials. In this work, we examine electron-phonon interactions in epitaxial ultrathin films of $La_{1-x}Sr_xMnO_3$ grown by molecular beam epitaxy (MBE) on single-termination $SrTiO_3(001)$ substrates as a function of chemical doping, film thickness, electrostatic gate doping, and applied magnetic field. For Sr dopings near the ferromagnetic-antiferromagnetic (FM-AFM) phase transition, a sharp feature in transport and magnetization is observed, coinciding with the phonon softening that occurs in $SrTiO_3$ at the phase transition near 100 K. We show that this effect can be modeled by the increase in the population of the F_{2u} phonons in $SrTiO_3$, which couple to the phonon modes of the LSMO. This coupling leads to a large modification in the electron hopping rates, with attendant changes in electronic, transport and magnetic behavior. We also discuss the connection between the orbial ordering in the AFM phase and the strong electron-phonon and phonon-magnon coupling.

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