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Optical Properties of \((\text{SrMnO}_3)_n/(\text{LaMnO}_3)_{2n}\) Superlattices: An Insulator-to-Metal Transition Observed in the Absence of Disorder

We measure the optical conductivity, \(\sigma_1(\omega)\), of \((\text{SrMnO}_3)_n/(\text{LaMnO}_3)_{2n}\) superlattices (SL) for \(n=1, 3, 5, 8\) and \(10 < T < 400\) K. Data show a T-dependent insulator to metal transition (IMT) for \(n=3\), driven by the softening of a polaronic mid-infrared band. At \(n=5\) that softening is incomplete, while at the largest-period \(n=8\) compound the MIR band is independent of T and the SL remains insulating. One can thus first observe the IMT in a Manganite system in the absence of the disorder due to chemical doping. Unsuccessful reconstruction of the SL optical properties from those of the original bulk materials suggests that \((\text{SrMnO}_3)_n/(\text{LaMnO}_3)_{2n}\) heterostructures give rise to a novel electronic state.

Figure: \(\sigma_1(\omega)\) at \(T = 10\) K, for the \(n=1, 3, 5, 8\) compounds, showing a Mott transition induced by the proximity between the layers. From A. Perucchi et al., Nano Letters 10, 4819 (2010).