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Physikalisches Kolloquium

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13:00 Uhr
MC 122 und Zoom

https://uni-due.zoom-x.de/j/64228670246?pwd=RjVQeFNIUkRKRkpiNVpKYXhJaFNLdz09

Giving me excitations, pickin' up good vibrations - 2D electron gases at oxide interfaces

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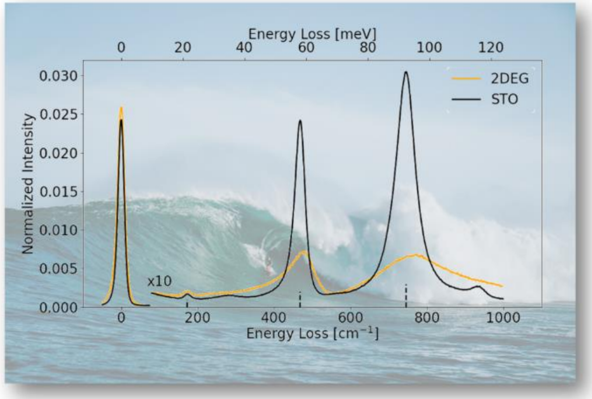
The observation of unexpected two-dimensional transport properties at surfaces and interfaces of oxide perovskites with otherwise large bandgaps, as e.g., for SrTiO3 and KTaO3, opened a wide field for fundamental physics and applications [1-3]. These properties arise from the formation of a two-dimensional electron gas (2DEG) at the interface, which offers a rich playground for spintronic applications. The low-energy excitations, as e.g. electron-hole pair excitations and their coupling to low-energy phonons and phonon polaritons are essential. For the 2DEG transport properties

Here I will discuss the low-energy excitations of the bare SrTiO3(001) and KTaO3(001) surfaces, especially their surface phonons. We will compare them with excitations in the presence of 2DEGs with variable charge carrier concentrations. By surface vibrational spectroscopy (high-resolution electron energy loss spectroscopy, HREELS) we identify three well-defined surface phonon polaritons for bare perovskite surfaces. Different 2DEG states are prepared on SrTiO3(001) and KTaO3(001) either by annealing under ultrahigh vacuum condition or by growth of an ultrathin layers of EuO on top. With formation of these 2DEGs, the discrete surface phonon polaritons couple to the electron-hole pair continuum as is witnessed by a substantial line broadening and asymmetric Fano-like line shapes. A quantitative description will be presented that accounts for all details of the line shape and paves the way for an in-situ analysis of the 2DEG charge carrier dynamics.

Fig. 1: Surface waves (phonon polaritons) at the SrTiO3(001)-vacuum interface as detected by inelastic electron scattering. The black line shows the bulk-like terminated surface, whereas the yellow line is the response in the presence of a two-dimensional electron gas at the interface. The three fundamental surface modes are marked and asymmetrically broadened by electron-phonon coupling.



[1] A. F. Santander-Syro et al., Nature, 2011, 469, 189
[2] J. Varignon, L. Vila, A. Barthélémy, and M. Bibes, Nat. Phys., 2018, 14, 322
[3] L. M. Vicente-Arche et al., Adv. Mat., 2021, 33, 2102102