

Poster-1-36

Variable-temperature and gate-tunable SNOM imaging of phonon-polaritons in STO and LAO/STO interfaces

Yixi Zhou, Adrien Waelchi, Margherita Boselli, Adrien Bercher, Iris Crassee, Willem Rischau, Weiwei Luo, Stefano Gariglio, Jean-Marc Triscone, and Alexey B. Kuzmenko

Department of Quantum Matter Physics, University of Geneva, CH-1211 Geneva 4, Switzerland

Surface phonon polaritons (SPhPs)-light waves coupled to lattice vibrations in polar crystals offer unprecedented opportunities to achieve enhanced light-matter interactions in a broad-band frequency range, spanning from mid-infrared to terahertz frequencies [1]. Such low-loss polariton modes are of great importance for the applications in biosensing, optical imaging and data storage. We performed cryogenic hyperspectral imaging of the propagating SPhP mode in SrTiO₃ (STO) and LaAlO₃/SrTiO₃ (LAO/STO) [2,3,4] system. In the LAO/STO, where the SPhPs electromagnetically couple with the plasmonic modes in the two-dimensional electron system (2DES), we observe a stronger temperature dependence of the SPhP band as compared to the pristine STO, which is related to the enhanced electron-phonon interaction in the doped STO layer. Furthermore, by applying electrostatic gating to the 2DES, we achieve a dynamic spectral tunability of the SPhP band. Our experimental results are supported by analytic calculations. Overall, our findings suggest SrTiO₃ as to be a new promising platform for nanophotonic applications, according to recent theoretical predictions [5], in the meanwhile, providing more tractable approaches for effective spectral shift of SPhPs taking the benefit of 2DES.

[1] J. D. Caldwell, L. Lindsay, V. Giannini, I. Vurgaftman, T. L. Reinecke, S. A. Maier and O.J. Glembocki, *Nanophotonics* 4: 44 (2015).

[2] A. Ohtomo and H.Y. Hwang, *Nature* 427, 423 (2004).

[3] S. Thiel, G. Hammerl, A. Schmehl, C.W. Schneider, and J. Mannhart 313, 1942 (2006).

[4] A.D. Caviglia, S. Gariglio, N. Reyren, D. Jaccard, T. Schneider, M. Gabay, S. Thiel, G.

[5] N. Kalfagiannis, J. Stoner, J. Hillier, I. Vangelidis and E. Lidorikis, *Journal of Materials Chemistry C* 7, 7851 (2019).