UNIVERSITÉ DE GENÈVE
DQMP Department of Quantum Matter Physics

DQMP Forum

Tuesday, Feburary 22nd, 2022 - 13h00
Auditoire Stückelberg and Zoom with ID: 799 1837 469

Coffee and tea will be available if you make it for yourself at home or in the lab

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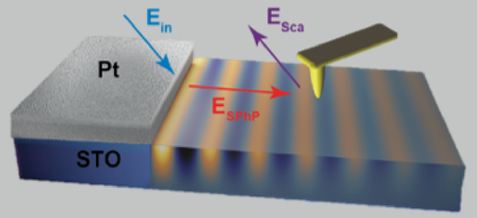
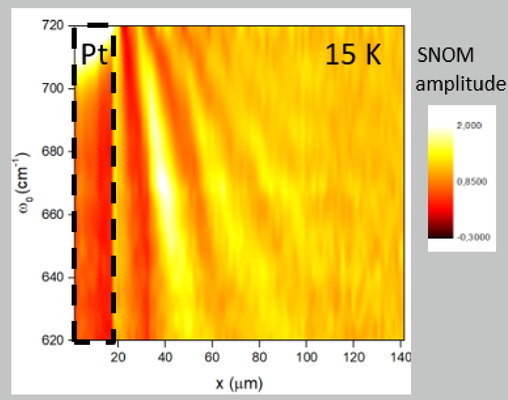
Variable-temperature and Gate-tunable SNOM Imaging of Phonon-polaritons in STO and LAO/STO Interfaces

Yixi Zhou
(group of Dr. Kuzmenko)

Surface phonon polaritons (SPhPs)—light waves coupled to lattice vibrations—in polar crystals offer unprecedented opportunities to achieve enhanced light-matter interactions in a broadband frequency range, spanning from mid-infrared to terahertz frequencies. Such low-loss polariton modes are of great importance for the applications in biosensing, optical imaging and energy harvesting.

In this talk, I will present our recent study of phonon polaritons in strontium titanate ($SrTiO_3$), which is a well-known material for oxide electronics, however, little studied as a polaritonic medium until now. We conduct variable-temperature scanning near-field optical microscopy (SNOM) on pristine $SrTiO_3$ and on $LaAlO_3/SrTiO_3$ interfaces, where the SPhPs electromagnetically couple with the plasmonic modes in the two-dimensional electron gas (2DEG). The propagation distance of the SPhPs in the pristine $SrTiO_3$ is found to be about 100 microns, comparable with the values seen in the best plasmonic materials. In the $LaAlO_3/SrTiO3$ system, we observe a stronger temperature dependence of the SPhP spectral band as compared to the pristine $SrTiO_3$. Moreover, by applying the gate voltage to the 2DEG, we achieved an additional variation of the dispersion of the phonon-polaritons. Our experimental results are supported by analytic calculations.





Probing the Behaviour of Surface Water and Ferroelectric $PbTiO_3$ Thin Films as Function of Environmental Parameters

Loïc Musy
(group of prof. Paruch)

A better understanding of the interplay between adsorbates and ferroelectric polarization is key to improving both our fundamental understanding of domain stabilization and unlocking novel applications, such as improved chemical reactions through polarisation-mediated catalysis.

Through a recent investigation of the behaviour of water on ferroelectric $PbTiO_3$ thin film surfaces under conditions of high humidity and low temperature, we observed extremely low charge dissipation and high localisation of both positive and negative screening charge on patterned domain structures in films with varying as-grown polarisation states. In local measurements during temperature cycling at low and high humidities, we also note that both polarisation orientation and the presence of written domains appear to influence the nucleation and growth of ice-like water allowing sub-micron control of water layer growth.