-Title: Active and Passive Tuning of Ultranarrow Resonances in Polaritonic Nanoantennas

-Abstract: Optical nanoantennas are of great importance for photonic devices and spectroscopy due to their capability of squeezing light at the nanoscale and enhancing light–matter interactions. Among them, nanoantennas made of polar crystals supporting phonon polaritons (phononic nanoantennas) exhibit the highest quality factors. This is due to the low optical losses inherent in these materials, which, however, hinder the spectral tuning of the nanoantennas due to their dielectric nature. Here, active and passive tuning of ultranarrow resonances in phononic nanoantennas is realized over a wide spectral range (≈35 cm^{-1}, being the resonance linewidth ≈9 cm^{-1}), monitored by near-field nanoscopy. To do that, the local environment of a single nanoantenna made of hexagonal boron nitride is modified by placing it on different polar substrates, such as quartz and 4H-silicon carbide, or covering it with layers of a high-refractive-index van der Waals crystal (WSe_2). Importantly, active tuning of the nanoantenna polaritonic resonances is demonstrated by placing it on top of a gated graphene monolayer in which the Fermi energy is varied. This work presents the realization of tunable polaritonic nanoantennas with ultranarrow resonances, which can find applications in active nanooptics and (bio)sensing.