Molecular optical spectroscopy and microscopy at the atomic scale

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Scanning Tunneling Microscopy (STM) provides a perfect configuration to explore light emission from single organic molecules [1,2].

A general theoretical framework which describes the coupling of an exciton and a plasmonic picocavity serves to reproduce and interpret the spectral information of light emission in STM, as well as the intensity emission maps with intramolecular resolution [3].

On top of the intensity maps, the control of the plasmonic cavity within the STM configuration allows for tracing the Purcell factor (broadening of emission), Lamb shift (energy shift of emission), and Stark effect (static shift of emission) in the emission of a free-base phthalocyanine (H_2Pc) in an STM cavity [4].

Light emission from organic chromophores in picocavities allows for bringing cavity quantum electrodynamics (c-QED) to the realm of the nanoscale, opening avenues to control excitonic states of matter at the single molecule level, and use light-matter polaritonic states associated with molecules in engineering of chemical reactivity and in tailoring quantum information technologies with polaritonic q-bits.

References

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Figures

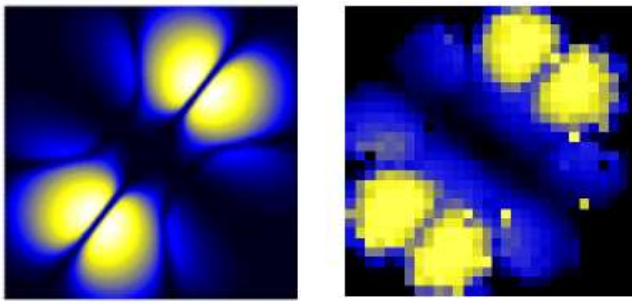

Figure 1: Left: Esperimental map of light emission from a free-base phthalocyanine (H_2Pc) deposited on an NaCl-Ag(111) surface when scanned in a STM cavity. The area of scanning is 2.5 x 2.5 nm^2, and the bias voltage applied is V=-2.5 V, with a current I= 100 pA. Right: Theoretical map of light emission under the same circumstances as in the experiment. The spectral range of light emission considered is at the excitonic emission line around 1.975 eV.