Selectively Addressing Plasmonic Modes and Excitonic States in a Nanocavity Hosting a Quantum Emitter

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Controlling the interaction between the excitonic states of a quantum emitter and the plasmonic modes of a nanocavity is key for the development of quantum information processing devices. In this contribution we demonstrate that the tunnel electroluminescence of electrically insulated C60 nanocrystals enclosed in the plasmonic nanocavity at the junction of a scanning tunneling microscope can be switched from a broad emission spectrum, revealing the plasmonic modes of the cavity, to a narrow band emission, displaying only the excitonic states of the C60 molecules by changing the bias voltage applied to the junction. Interestingly, excitonic emission dominates the spectra in the high-voltage region in which the simultaneously acquired inelastic rate is low, demonstrating that the excitons cannot be created by an inelastic tunnel process. These results point toward new possible mechanisms for tunnel electroluminescence of quantum emitters and offer new avenues to develop electrically tunable nanoscale light sources.

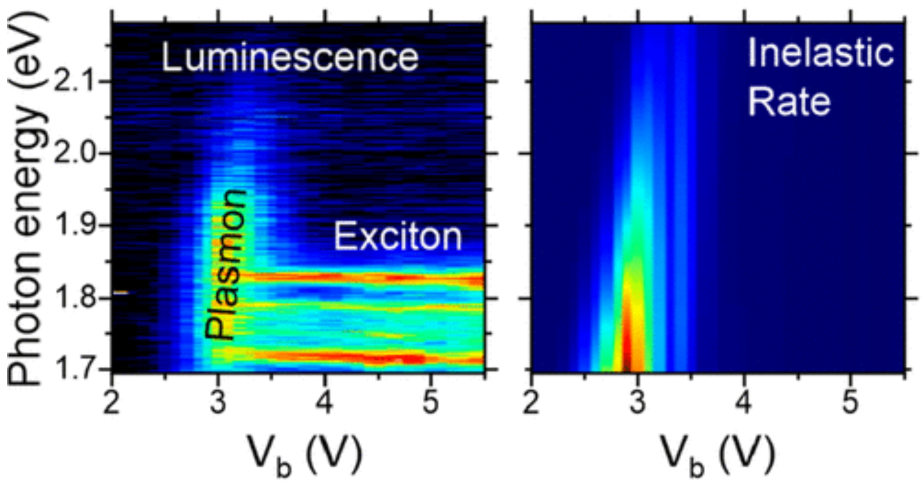

Fig. 1. (Left panel) Tunnel electroluminescence spectra acquired on C60 islands on 2ML NaCl/Ag(111) (in color code) as a function of the bias voltage applied to the junction. Broad plasmonic modes are obtained for bias voltages below 3.3 V, whereas excitonic resonances are observed for higher bias voltages. (Right panel) Rate of inelastic transitions as a function of the energy loss and bias voltage as a function of the applied bias voltage, obtained from the I(V) curves. Comparison between both panels demonstrates that plasmonic emission is triggered by inelastic tunnel events, whereas excitonic emission is not.

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