Optical Properties of Monoatomic Step Edges in Noble Metals Studied by STM

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The light spectra radiated by nanocavities formed due to the tunnel junction between a Scanning Tunneling Microscope (STM) atomically sharp tip and a metal surface is inherently composed by the contribution of the localized plasmon de-excitation modes but also by the electronic structure properties of the system [1] . Using a fully experimental normalization procedure involving Scanning Tunneling Spectroscopy and Scanning Tunnelling Microscope Luminescence measurements, we are able to detach both contributions in order to further studying the luminescence properties of Ag(111) surface monoatomic step-edges. Our results show the emergence of a sharp drop of the plasmonic intensity within the step-edge which disappears in the normalized data. That means that the sudden variation of the light intensity is exclusively promoted due to electronic processes with the optical modes of the nanocavity remaining unchanged.

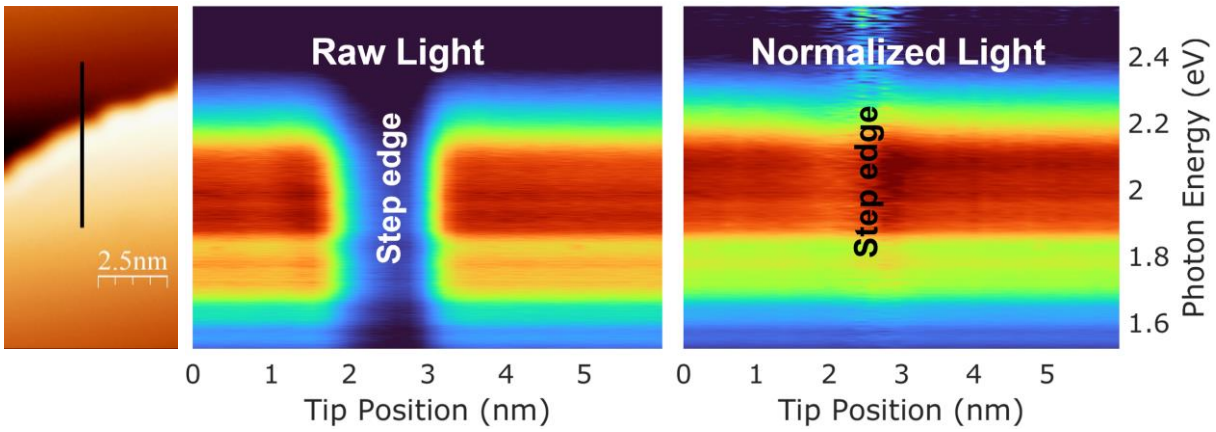

Fig. 1. ***– (Left Panel)*** *STM image of an Ag 111 monoatomic step-edge measured at V_{bias} = 2.6V and I_t = 5pA. The line (6nm) crossing the monoatomic step edge represent the points where both light spectra and I(V) curves have been taken* ***(Center Panel)*** *Map representation of the raw light spectra collected from the tunnel junction as a function of the photon energy and tip position along the line drawn in left panel* ***(Right Panel)*** *Map representation of the normalized light spectra using raw light spectra and the rate of inelastic processes.*

[1] A. Martín-Jiménez, A. I. Fernández-Domínguez, K. Lauwaet, D. Granados, R. Miranda, F. J. García-Vidal, and R. Otero, Unveiling the radiative local density of optical states of a plasmonic nanocavity by STM, Nature Communications 11, 10.1038/s41467-020-14827-7 (2020).