STM-induced light emission: from molecular LED to subnanometric optical microscopy.

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The electric current traversing the junction of a scanning tunneling microscope (STM) may generate a local emission of light. During the last years, we have used this method to study the intrinsic luminescence properties of individual molecules. This work has progressed in two directions. On one side we have used the ability of the STM to manipulate matter with atomic-scale precision to form single-molecule light emitting devices [1]. Composed by individual molecular wires suspended between the tip and the sample of the STM (see figure), these devices generate an emission of light whose color, intensity and bandwidth can be controlled with high precision [2,3]. On the other side, we used the intrinsic resolution of the STM to performed sub-molecularly resolved vibronic spectroscopy of molecules separated from a metallic surface by a thin insulating layers [4]. Together with other recent reports [5,6], this result constitutes an important step towards photonic measurements with atomic-scale resolution.

[1] G. Reecht et al., Phys. Rev. Lett. 112, 047403 (2014)
[2] M.C. Chong et al., Phys. Rev. Lett. 116, 036802 (2016)
[3] M.C. Chong et al., Nanoletters 16, 6480 (2016)
[4] B. Doppagne et al., Phys. Rev. Lett. 118, 127401 (2017)
[5] Y. Zhang et al. Nature 531, 623 (2016)
[6] H. Imada et al., Nature 538, 364 (2016)

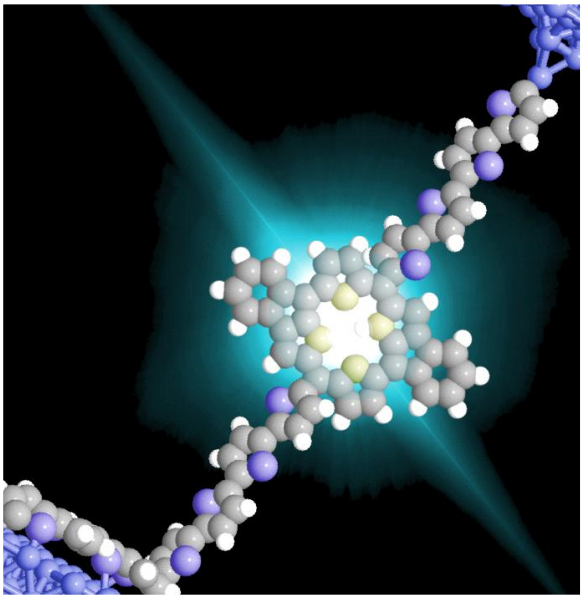

Figure : Artistic view of a single-molecule optoelectronic device operated with a scanning tunnelling microscope.