High voltage STM imaging of single Copper Phthalocyanine

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Sixty years ago, Erwin Müller used his newly developed electron microscopy technique (the Field Emission Microscopy) to image for the first time and in real space the electronic cloud of a large organic molecule [1]. By using voltages in the range of 10 kilovolts to reach a FEM regime, E. Müller observed and "photograph" single Cu-Phthalocyanine (CuPc) molecules previously deposited on the emitting tungsten tip. From this period of time, CuPc became a molecule of choice for new microscopy techniques. For example, CuPc was used to test the capabilities to image the electronic cloud of organic molecules in real space with the Transmission Electron Microscope (TEM) which is another microscopy technique using electrons accelerated via a high voltage potential.

In our days, the possibility of imaging molecules in real space is not restricted to the use of highly accelerated ballistic electrons. With the Scanning Tunneling Microscope (STM) and with a tunneling junction bias voltages of a few volts (± 3 V), tunneling electrons give access to a map of molecule electronic states near the substrate's Fermi level [2,3], of molecules weakly coupled i.e. physisorbed on a metal surface.

Herein, we have used a low temperature STM to image single CuPc molecules deposited on Au(111) with a junction bias voltage larger than the normally used voltage window. Bias voltages up to 10.0 V were used. In this STM field emission regime [4], our interpretation of the process enabling the visualization of electronic cloud of a single CuPc molecule under these conditions will be presented.

References:

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