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Motion and Photon Emission of Single Molecules in Space-Time[1]
JOONHEE LEE, SHAWN PERDUE, ALEJANDRO RODRIGUEZ PEREZ, V. ARA APKARIAN, University of California, Irvine, DEPARTMENT OF CHEMISTRY TEAM — We have visualized tunneling electron induced motion of single Zn-Etioporphyrin molecules adsorbed on the thin oxide film grown on NiAl(110) surface using scanning tunneling microscopy (STM). When tunneling electrons are injected resonantly to an unoccupied molecular orbital, nearly bistable switching in tunneling current occurs and the molecule starts exhibiting vibronic progression in its photon emission spectra. The switching behavior was spatially mapped by recording time traces on individual pixels of an STM image. We reconstruct the motion using the spatial distribution of amplitude, frequency, and on-time of the switching, and interpret it as the planar hindered rotation shuttling between two different adsorption configurations. The angle of rotation is close to 45 degrees, and the on-time reveals the nature of local potential barrier. Due to the two fold symmetry of the molecules under interrogation, the conductance switching shows different polarities. The electronic excitation of the molecule leads to vibronic transition in which the molecule emits photons and vibrates inside the local potential wells. Considering significant corrugation of oxide surfaces, rotation mediated by quantum tunneling of ethyl groups of the molecule will be discussed.

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