

Abstract Submitted
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Statistics of single molecule rotation driven by electrons

CHARLES SYKES, Tufts University — In stark contrast to nature, current man-made devices, with the exception of liquid crystals, make no use of nanoscale molecular motion. In order for molecules to be used as components in molecular machines, methods are required to couple individual molecules to external energy sources and to selectively excite motion in a given direction. Recently a new, stable and robust system of molecular rotors consisting of thioether molecules bound to metal surfaces has offered a method with which to study the rotation of individual molecules as a function of temperature, molecular chemistry, proximity of neighboring molecules, and surface structure [1,2]. Arrhenius plots for the rotation of dibutyl sulfide yielded a rotational barrier of 1.2 kJ per mol. While these results reveal that small amounts of thermal energy are capable of inducing rotation, thermodynamics dictates that thermal energy alone cannot be used to perform useful work in the absence of a temperature gradient. Electrical excitation of individual thioether molecular rotors is performed using with electrons from a scanning tunneling microscope tip. Experimental data for the electrically excited motion of asymmetric thioether molecules is presented and the statistics of and mechanism for directed motion is discussed [1,2].

[1] “A Quantitative Single-Molecule Study of Thioether Molecular Rotors” A. E. Baber et al. ACS Nano 2008, 2, 2385-2391

[2] Experimental Demonstration of a Single-Molecule Electric Motor H. L. Tierney et al. - Nature Nanotechnology 2011, 6, 625-629

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