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Dynamical Properties of Surface-mounted Dipolar Molecular Rotators JASON UNDERWOOD, JOHN PRICE, University of Colorado, Department of Physics, DOUGLAS CASKEY, JOSEF MICHL, University of Colorado, Department of Chemistry and Biochemistry — We use dielectric relaxation spectroscopy (DRS) to study the rotational dynamics of dipolar molecules mounted on fused SiO_2 surfaces. Each "molecular rotor" consists of three parts: 1) a mounting group for attachment to the substrate, 2) a rotating group having a permanent dipole moment, and 3) an axis connecting the rotor to the attachment group. Attachment is facilitated either by covalent bonding through reaction of silane groups with surface hydroxyls or by van der Waals interactions. Fused SiO_2 substrates are patterned with interdigitated electrode Au capacitors ($C \simeq 1$ pF), and rotor molecule dynamics are characterized by measurement of the capacitance C and loss tangent $\tan\delta \equiv \mathrm{Re\{Z\}/Im\{Z\}}$. We employ a ratio-transformer bridge technique to measure these quantities, with sensitivities in C and $\tan\delta$ of 1 aF and 1 ppm, respectively. A unique aspect of this work is the experimental apparatus, which allows us to prepare sub-monolayer films, determine coverage via two independent methods (DRS and XPS), and study molecule rotational motion, in-situ in ultra-high vacuum. Results will be presented on the kinetics of rotor adsorption/desorption, barrier height and asymmetry of the rotational potential of the molecules, and the effects of varying rotor coverages and adventitious H_2O.

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