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Real Space Rotational Spectroscopy: Measurement of the Rotational Excitation of a Single Molecule by the Scanning Tunneling Microscope SHAOWEI LI, ARTHUR YU, FREDDY TOLEDO, ZHUMIN HAN, WILSON HO, University of California, Irvine — The power of rotational transition spectra has long been demonstrated in the frequency domain by microwave spectroscopy, but its application in real space is limited. Using a scanning tunneling microscope (STM) and inelastic electron tunneling spectroscopy (IETS), we are able to conduct real-space measurements of rotational transitions of gaseous hydrogen molecules physisorbed on Au(110) surface. By varying the tip-substrate distance, we could precisely investigate how the environmental coupling modifies the structure of a single molecule with sub-Angstrom resolution. Rotational spectroscopy at the single molecule level provides a powerful tool for chemical identification as well as bond length measurement in both frequency and space domains.

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