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**High Resolution Vibrational Spectroscopy at the Atomic Scale: CO on Au(110) and Cu(100), and C<sub>2</sub>H<sub>2</sub> on Cu(100)** CHEN XU<sup>1</sup>, CHILUN JIANG<sup>2</sup>, YANNING ZHANG, RUQIAN WU, WILSON HO, Department of Physics and Astronomy, University of California, Irvine — STM-IETS has been regarded as the ultimate tool to identify and characterize single molecules adsorbed on solid surfaces with atomic spatial resolution. With the improvement of the energy resolution obtained at ~600 mK, STM-IETS is able to reveal subtle interactions between the molecule and its environment which was previously not possible at higher temperatures. Here we demonstrate the capability of sub-Kelvin STM on detecting the influence of the tip as well as the anisotropy of the reconstructed Au(110) surface on the low energy hindered vibrational motions of single adsorbed CO molecule. In the case of acetylene, more vibrational modes are resolved due to the enhanced spectral resolution. Single molecule vibrational spectroscopy with atomic scale spatial resolution opens new possibilities to probe molecular interactions with high spectral resolution.

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