

Surface Action Spectroscopy with Rare Gas Messenger Atoms

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Action spectroscopy with rare gas messenger atoms is commonly used for the characterization of aggregates in the gas phase.[1] Vibrational spectra of aggregates with attached rare gas atoms are measured with this method via detection of rare gas desorption following a vibrational excitation with variable-energy infrared light. We have constructed an apparatus for the application of action spectroscopy with rare gas messenger atoms to surfaces of solids. [2] A new apparatus was set up at the Fritz Haber Institute (FHI) and connected to the FHI FEL, which is able to provide intense and widely tunable (3 – 60 μm) IR radiation. Experiments performed for neon covered $\text{V}_2\text{O}_3(0001)$ show that this method can provide information about surface vibrations. Besides this surface-sensitive channel there is also a bulk-sensitive one as demonstrated with the example of rutile $\text{TiO}_2(110)$ single crystal data. Unlike IRAS, normalization to a reference spectrum is not required for action spectroscopy data and unlike HREELS, the action spectroscopy method does not suffer from moderate resolution nor from multiple excitations. Selective decoration of specific surface features with rare gas messenger atoms may be utilized to focus the spectroscopic information onto these features.

References:

[1] A. Fielicke et al., Phys. Rev. Lett. 93, 023401 (2004).

[2] Z. Wu et al., Phys. Rev. Lett. 119, 136101 (2017).