Magnetic excitations induced and studied with the Scanning Tunneling Microscope

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Electron currents can induce magnetic excitations in molecular nanostructures. Magnetic inelastic electron tunneling spectroscopy (IETS) shows sharp increases in conductance when a magnetic excitation is induced by the travelling electron. A previous one-electron theory [1] successfully explained both the conductance thresholds and the magnitude of the conductance variation in a variety of atomic and molecular adsorbates [2]. Besides inelastic spin flips, elastic spin fl ips of conduction electrons by magnetic impurities lead to the well-known Kondo effect. We will compare the theoretical predictions for inelast ic magnetic tunneling obtained with a one-electron approach and with a many-body theory including Kondo-like phenomena [3]. We apply our theories to a singlet-trip let transition model system that contains most of the characteristics revealed in magnetic IETS. We use two self-consistent treatments (non-crossing approxim ation and self-consistent ladder approximation). One of the main findings is tha t many-body effects translate into sharp peaks that appear close to the inelasti c thresholds; these are not localized exactly at thresholds and any deviation fr om the one-electron threshold may render more difficult the extraction of magent ic anistropy features for IETS experiments. Regarding the Kondo effect, we show that the inclusion of inelastic effects in the impurity leads to an enhancement of the electronic coherence and hence of the Kondo temperature contrary to what is found when inelastic effects of the substrate are included.

References

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