How to distinguish between interacting and noninteracting molecules in tunnel junctions

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Recent experiments demonstrate a temperature control of the electric conduction through a ferrocene-based molecular junction. Here we examine the results in view of determining means to distinguish between transport through single-particle molecular levels or via transport channels split by Coulomb repulsion. Both transport mechanisms are similar in molecular junctions given the similarities between molecular intralevel energies and the charging energy. We propose an experimentally testable way to identify the main transport process [1]. By applying a magnetic field to the molecule, we observe that an interacting theory predicts a shift of the conductance resonances of the molecule whereas in the noninteracting case each resonance is split into two peaks. The interaction model works well in explaining our experimental results obtained in a ferrocene-based single-molecule junction, where the charge degeneracy peaks shift (but do not split) under the action of an applied 7-Tesla magnetic field. This method is useful for a proper characterization of the transport properties of molecular tunnel junctions.

[1] Miguel A. Sierra, David Sanchez, Alvar R. Garrigues, Enrique del Barco, Lejia Wang, and Christian A. Nijhuis, Nanoscale 10, 3904 (2018).