Electron-phonon interaction and quantum interference in molecular junctions

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Abstract (Arial 10)
Recent experiments have highlighted the role of destructive quantum interference in transport through single molecule devices [1,2,3] or large area molecular junctions [4]. The ability to control the wave nature of electrons at the molecular level is a new development in molecular electronics that could improve knowledge and control of electron transport through molecular systems. Cross-conjugated molecules, such as anthraquinone, can behave as molecular quantum interferometers where the interference is due to different paths through the molecular orbitals of the molecule. The signature of quantum interference in molecular system is an antiresonance in the electron transmission function resulting in a strong suppression of conductance at low bias voltage. However, most of the experiments have been conducting in ambient conditions and the influence of temperature and the role played by the excitations on this effect are still not known.
I will present our measurements of the influence of electron-phonon interaction on quantum interference in anthraquinone molecular layers embedded in large-area solid-state devices. We have found that the conductance is strongly dependent both on voltage and on temperature. The temperature dependence and the shape of the conductance curves are well accounted by a theoretical model including electron-phonon interaction in agreement with recent theoretical results [5]. The temperature effect is due both to the broadening of the Fermi functions of the leads and to the electron-phonon interaction. Signatures of the phonon energies are visible in the conductance curve at low temperature. We believe that our findings open up new avenues in engineering the electronic properties of molecular devices.

References

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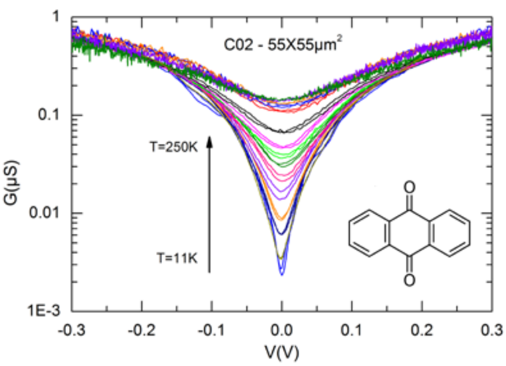
Figures



Measured conductance as a function of applied voltage of an anthraquinone based junction for temperatures varying between 11 k and 250 K.