Abstract for an Invited Paper
for the MAR10 Meeting of
The American Physical Society

Controlling Electronic States and Transport Properties at the Level of Single Molecules[1]

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Since molecular electronics has been rapidly growing as a promising alternative of conventional electronics towards the ultimate miniaturization of electronic devices through the bottom-up strategy, it has become a long-term desire to understand and control the transport properties at the level of single molecules. In this presentation we show that one may modify the electronic states of single molecules, and thus control their transport properties through designing and fabrication of functional molecules or manipulating molecules with scanning tunneling microscopy. We demonstrated that the rectifying effect of single molecules can be realized by designing donor-barrier-acceptor architecture of Pyridine-σ-C_{60} molecules to achieve the Aviram-Ratner rectifier through azafullerene $C_{59}N$ molecules The effect of the negative differential resistances can be realized by appropriately matching the molecular oribital symmetries between a cobalt phthalocyanine (CoPc) molecule and a Ni electrode. The electronic states and transport properties of single molecules, such as CoPc and melamine molecules, can be altered through manipulation or modifying molecular structures, leading to functionalized molecular devices.

[1]This research was supported by NBRP (2006CB922000) and NSFC (50721091, 10825415), China.