STM/STS studies on Europium nanowires encapsulated in carbon nanotubes

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The discovery of carbon nanotubes (CNTs) and their fascinating properties have ignited intense research interests on one-dimensional nanosystems. Although ultrathin atomic wires are one of the ideal one-dimensional systems, preparation of the ultrathin wires with diameters of 1–several nanometers has been difficult. Previously, we have reported the synthesis and characterization of ultrathin metal nanowires encapsulated in CNTs.[1][2] Here, we present the preparation and investigation of spatially-resolved electronic structure of Eu nanowires encapsulated in CNT (EuNW@CNT) by scanning tunneling microscopy/spectroscopy (STM/STS).

EuNW@CNT was synthesized by the direct nano-filling method[1] and deposited on Au(111) surface by the pulsed-jet deposition technique.[3] Figure 1 shows a STS spectrum of EuNW@CNT, where a new peak due to a localized density of states (DOS) of the encapsulated Eu nanowire can be seen. Figure 2 shows a dI/dV mapping observed at a bias voltage of -0.4 V, which corresponds to the voltage where the new DOS peak was observed. The bright region in the dI/dV map corresponds to the position where the encapsulated Eu nanowire locates. Spatially-resolved STS spectra reveal the position of Eu atoms in EuNW@CNT directly, which leads to a precise assignment of the STS peak and the interaction between Eu nanowires and CNTs.


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