Molecular Maracas: Investigating the potential of Li@C_{60} as a multi-state molecular switch

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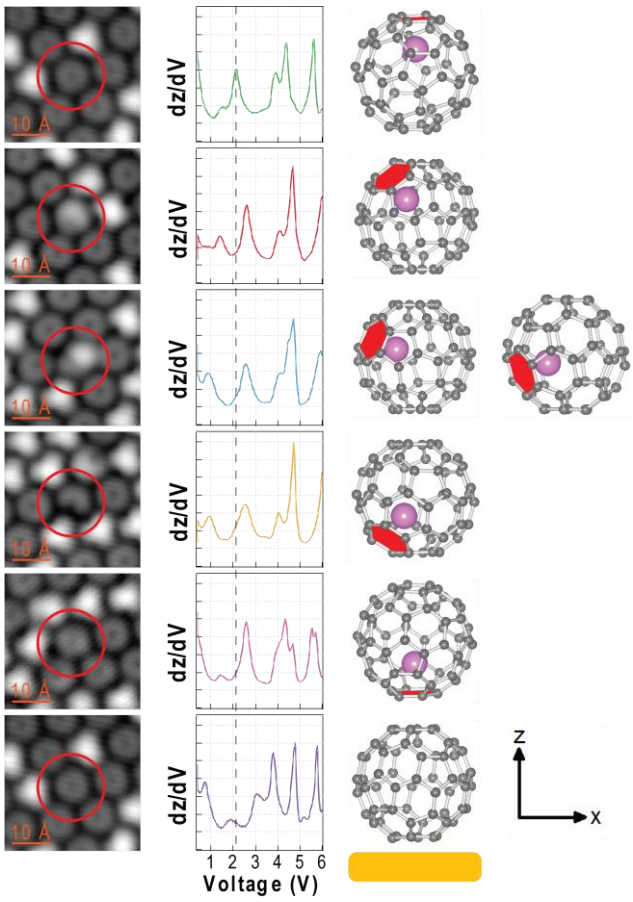

Figure 1; cc-STM scan parameters; -2.5 V, 0.1 nA, a-e) cc-STM images illustrating 5 of the distinct electronic levels of the Li@C_{60} switch, f) cc-STM image after the ejection of a Li^+ ion from the fullerene, g-l) graphs showing the dz/dV spectra for the corresponding STM images, the spectrum in l is identical to that of a C_{60}. This is proof that the fullerene exhibited in a and g is now empty, m-s) ball and stick models of the corresponding states of the Li@C_{60} when adsorbed to the Au(111) surface as illustrated.

A potential end-point in the miniaturization of electronic devices lies in the field of molecular electronics, where molecules perform the function of single components like transistors [1] and switches [2]. This idea has been around for decades [3] but recent years have shown real progress in the field. A molecular switch is defined as a molecule that displays stability in two or more states (e.g. “on” and “off” involving conductance, conformation etc.) and upon application of a field, electric or otherwise, undergoes a reversible change such that the molecule is altered. Previous work has shown electric field induced multi-state molecular switches with up to four distinct states [4]. Here we report on a novel system using lithium endohedral fullerenes (Li@C_{60}) that has the potential to display up to twenty.

By using an ultra-high vacuum, low temperature scanning tunnelling microscope (UHV LT-STM) to apply an electric field to single molecules, we are able to randomly switch selected fullerenes into fourteen of these twenty available states. These states identify the position of the Li^+ around the inside surface of the C_{60} cage, since they preferentially stabilise closer to the hexagonal faces. Each state can then be analysed and discriminated between using a mixture of constant current scanning tunnelling microscopy (cc-STM) and dz/dV scanning tunnelling spectroscopy (STS).

References:
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