Probing single molecule transport with superconducting electrodes

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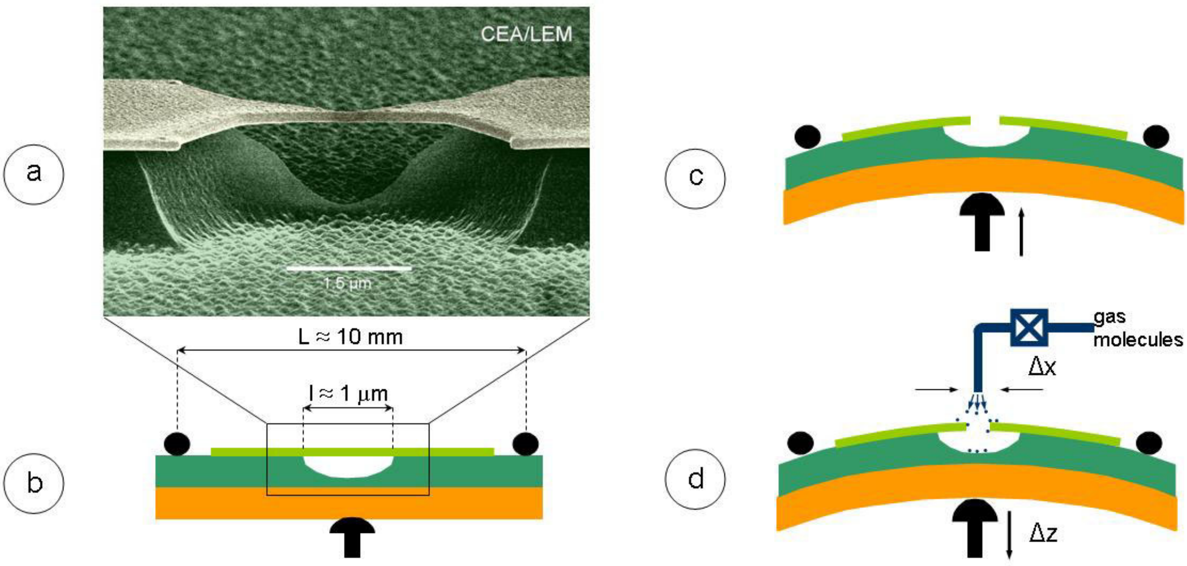
Elucidating the physics of transport through single molecules is a challenging quest that needs approaches complementing the usual transport measurements with normal metal electrodes. We investigated electronic transport through diatomic molecules attached to superconducting electrodes using the break-junction technique (see Figure) at low temperatures. As was recently demonstrated in atomic-size contacts, the richness of electronic transport in the superconducting state [1] allows to make evident the direct relation between the number of conduction channels through a single atom and its chemical valence [2]. Experiments on different diatomic molecules reveal the conduction channels through the metal-molecule-metal structure and allow a quantitative comparison with theoretical calculations. In particular, depending on the molecule, it is shown that conduction is enhanced or decreased.

References:

[1] E. Scheer et al., Phys. Rev. Lett., **78** (1997) 3535. M. F. Goffman et al., Phys. Rev. Lett., **85** (2000) 170. R. Cron, M. F. Goffman, D. Esteve and C. Urbina, Phys. Rev. Lett., **86** (2001) 4104.
[2] E. Scheer et al., Nature, **394** (1998) 154.

Figures:



(a) SEM colorized picture. A metallic bridge with dimensions ~100 nm is fabricated on an insulating elastic substrate, using conventional e-beam technique. (b) & (c) Using a bending mechanism consisting of 2 side counter-supports and a centred pushing rod, the bridge is elongated until it breaks. (d) The distance between the resulting electrodes is controlled at atomic scale, allowing to connect a single molecule.