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Quantum properties of atomic-sized conductors: Single atoms, chains of atoms, and molecules

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Using remarkably simple experimental techniques it is possible to gently break a metallic contact and thus form a conducting nanowire. Although the atomic structure of contacts can be quite complicated, as soon as the weakest point is reduced to just a single atom the complexity is removed. This has allowed for quantitative comparison of theory and experiment for many properties, and atomic contacts have proven to form a rich test-bed for concepts from mesoscopic physics (N. Agraït, A. Levy Yeyati and J.M. van Ruitenbeek, Phys. Rep. **377** (2003) 81). More recently, similar techniques are being used to contact and study individual organic molecules. Junctions of single molecules such as H₂ and CO bonded between Pt electrodes can be characterized in great detail by vibration spectroscopy and the dependence of the vibration modes on the stretching of the junction (R.H.M. Smit, et al., Nature **419** (2002) 906; D. Djukic, J.M. van Ruitenbeek, K.S. Thygesen and K.W. Jacobsen, cond-mat/0409640).