Self-assembled contacts to nanoparticles using metallic Ga droplets

K. DU, E. GLOGOWSKI, M. T. TUOMINEN, T. EMRICK, T. P. RUSSELL, A. D. DINSMORE

Affiliation: Department of Physics, Department of Polymer Science and Engineering University of Massachusetts Amherst.

We demonstrate a pragmatic approach to forming electronic materials and devices, in which metal droplets serve as electrodes and their spacing is controlled spontaneously, via self-assembly, to allow tunneling contact with nanoparticles. We have fashioned devices consisting of droplets of molten metal (Ga). Ga is suspended in acidic solution. Ligand-stabilized Au nanoparticles in solution assemble on the metal surface, as shown by electron microscopy. Coated droplets which are then placed on a substrate and the solvent removed. Electron-transport measurements reveal the Coulomb blockade, in which current is suppressed below a tunable threshold voltage by the energy of charging individual nanoparticles. The threshold voltage for two different sizes of nanoparticles agrees with theory. Our approach provides a straightforward approach to creating nanoscale-precision contacts to nanoparticles and might lead to formation of a large number of microscopic devices from suspension.