MOLECULAR ELECTRONICS

Making the right contacts

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Credit: IBM Research — Zurich

Using the intrinsic functionality of a molecule to build electronic devices is an idea that can be traced back to the 1970s and the suggestion that a single molecule could function as a rectifier. More recently, sophisticated measurements with single-molecule junctions have yielded a variety of fundamental insights into the electronic properties of molecules. However, these junctions are affected by the minute details of their atomic configuration and thus using them to build reliable devices is difficult.

Devices that are based on ensembles of molecules can reduce device-to-device variation and are thus a more viable route to practical devices. These systems often use self-assembled monolayers (SAMs) of molecules that can spontaneously form on the surface of certain metals, but creating the additional top contact of the required metal–SAM–metal structure, without damaging the molecular layer, has proved challenging. Gabriel Puebla-Hellmann and colleagues have now shown that reliable top contacts can be created with the help of metallic nanoparticles.

The researchers — who are based at IBM Research — Zurich, the University of Basel, Macquarie University, the University of Zurich, the Karlsruhe Institute of Technology and Sun Yat-Sen University — etched circular pores in a dielectric layer that had been deposited on a platinum bottom electrode. Within these pores, dense molecular layers were self-assembled on the exposed platinum. Gold nanoparticles were then deposited from solution onto this SAM. Because the molecules in the layer (alkanedithiols) have two anchor groups, one at either end, the nanoparticles can bind to the top of the molecule, creating a film of particles. Direct metal evaporation was then used to add an additional thin metal layer to the top contact. With the approach, Puebla-Hellmann and colleagues were able to create around 3,000 identical devices.

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