Researchers boost electron energy loss spectroscopy signal using silver nanoparticles

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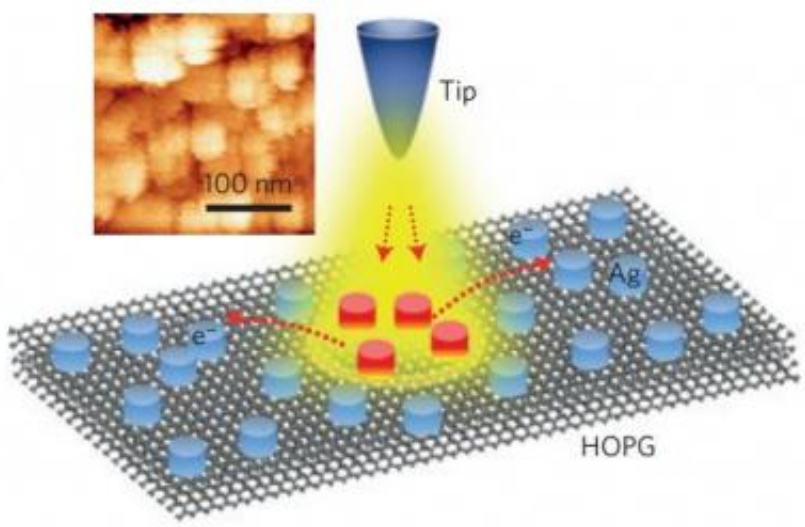

Experimental arrangement. A tip is approached to a distance of micrometres from a grounded highly ordered pyrolytic graphene (HOPG) surface carrying Ag nanostructures (illustrated in the inset). Electrons are field-emitted from the tip when a negative tip voltage Vt of hundreds of volts is applied, and the surface plasmon resonance (SPR) of the Ag nanostructures is excited by the field-emitted electrons under a strong electric field introduced by the tip–sample bias. The backscattered electrons are collected and analysed by the TEEA. Credit: *Nature Physics* (2014) doi:10.1038/nphys3051

(Phys.org) —A large team of physicists, chemists and physical scientists working in China has found a way to boost the signal received when

using electron energy loss spectroscopy—by adding silver nanoparticles to the target. In their paper published in the journal *Nature Physics*, the team describes how their new technique works and possible uses for it.

Electron energy loss spectroscopy is a type of electron microscope technique—information about a material is obtained by firing electrons at it and then analyzing the results of inelastic collisions with atoms in the material—such collisions offer information about individual atoms and their state. Unfortunately, during normal firing, only a very few inelastic collisions occur, most are elastic—the electrons simply bounce off the target without loss of energy, leaving little for the researchers to analyze. In this new effort, the researchers came up with a way to move the probe closer to the material and also found a way to increase the percentage of inelastic collisions that occur during a single scan thereby boosting the signal received and revealing much more information about the atoms that make up the target.

The team started by building their own probe—a charged tungsten tip that allowed for placing it closer to the target (within micrometers). To further boost the signal, they applied silver nanoparticles to the target—they serve to excite the electrons on the surface of the target, boosting Plasmon resonance, causing a loss of energy at the surface, which results in more inelastic collisions.

The researchers found they could change the signal strength by modifying the voltage they applied to their probe. To prove that it was the nanoparticles causing the change in signal, the team applied a very thin silver layer to the target and found no demonstrable change in the signal. They've named their new technique "nonlinear electron scattering spectroscopy" and believe it could prove useful in a wide variety of applications, e.g. nano-lithography, or printing and fabricating at a very small scale. Because it's so highly sensitive they suggest the technique could be used to ascertain the properties of single atoms sitting on the

surface of a material.

More information: Nonlinear inelastic electron scattering revealed by plasmon-enhanced electron energy-loss spectroscopy, *Nature Physics* (2014) DOI: 10.1038/nphys3051