Towards vapour sensing with graphene-metallic nanoparticle hybrids

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Abstract

Graphene covered metal nanoparticles (NPs) constitute a hybrid material which provides a unique platform to study plasmonic effects, surface-enhanced Raman scattering (SERS), and metal-graphene interactions at the nanoscale. Additionally, the corrugation of graphene can be tuned by the size and shape of the NPs, in order to enhance its chemical activity. This can open a route in tailoring the properties of graphene/nanoparticle hybrid structures towards sensing applications. We prepared such hybrid materials by transferring graphene onto closely spaced metallic nanoparticles produced on silica substrates. The properties of nanoparticle supported graphene were investigated by atomic force microscopy (AFM), optical reflectance spectroscopy, and confocal Raman spectroscopy [1].

We investigated the vapour sensing properties of different graphene-gold hybrid nanostructures. The experiments were carried out by changing the concentration and nature of the vapours (ethanol, isopropanol, and toluene), while monitoring the variations in the optical spectra near the local surface plasmon resonance of the gold nanostructures. The sample with smaller, dome-like gold nanoparticles were proved to be more sensitive to these vapours compared to the sample with slightly larger, flat gold nanoislands. We showed that the presence of graphene increases the sensitivity to ethanol and isopropanol, while it decreases towards toluene exposure (Figure 1) [2]. These results can have potential impact on the development of new sensors based on graphene-gold hybrids.

References

[1] András Pálinkás, Péter Kun, Antal A. Koós, Zoltán Osváth, Nanoscale, 10 (2018) 13417.
[2] Gábor Piszter, Krisztián Kertész, György Molnár, András Pálinkás, András Deák, Zoltán Osváth, Nanoscale Advances, 1 (2019) 2408.

Figures

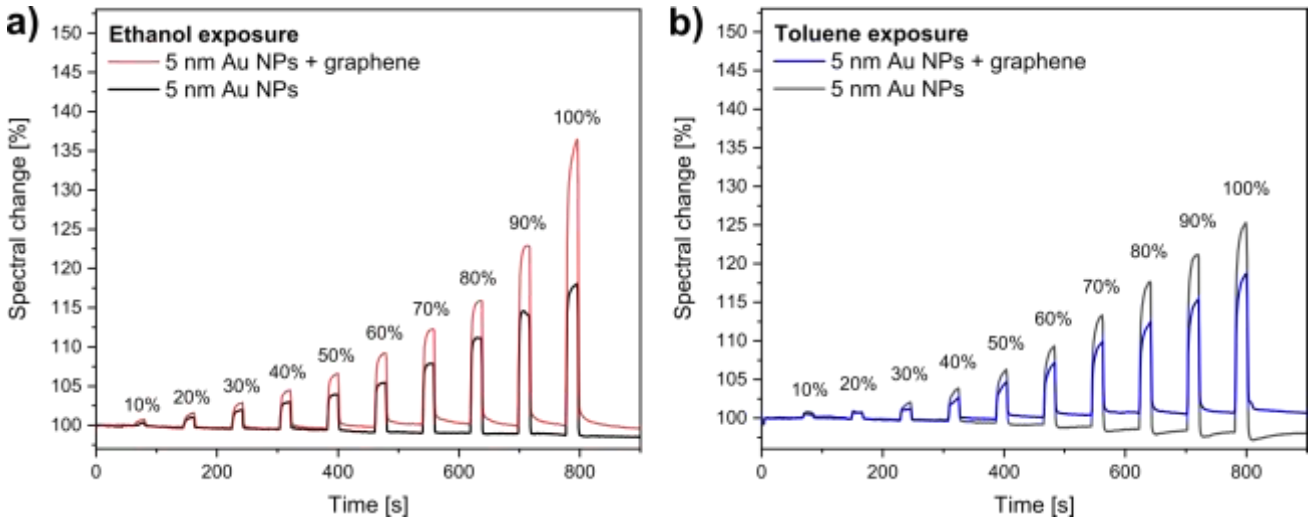

Figure 1: Optical responses of bare Au NPs (black lines) and graphene/Au NPs (coloured lines) upon exposure to (a) ethanol and (b) toluene.