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Templating Nanotraffic Light - Tricoloured Blinking Silver Nanoclusters on Graphene Oxide Film

Metal nanoparticles (NPs) such as silver (Ag)[1] and gold (Au)[2] captured the attention of many researchers for their multitudinous applications. These applications include photography,[3] surface enhanced Raman scattering (SERS),[2, 4] surface enhanced fluorescence (SEF),[5-7] catalysis[8, 9] and biological applications[10] such as copper(II) probes.[11] Of these metal NPs, Ag NPs is of interest due to its strong visible light emission[12, 13] and its ability to initiate strong SEF.[5, 7] By tuning factors such as size, shape and surrounding environment,[14] the optical properties of Ag NPs can easily be customised to suit the need of specific applications such as integrated optical storage,[15] biological sensors[10] and photon detector[16]. Among the many properties reported on AgNPs, perhaps one of the most fascinating properties is the fluorescence intermittency (multi-colored blinking) observed when the size of the AgNPs reduces to a few atoms. Silver at this regime is known as silver nanoclusters (Ag_n clusters, where *n* is the number of atoms). In this work, graphene oxide (GO) film is implemented as a superior substrate for the controlled anchoring and micropatterning of blinking silver nanoparticle-nanocluster hybrid. Localised laser reduction of GO film in the presence of $AgNO_3$ solution results in controlled deposition of Ag nanoparticles (NPs) onto the reduced GO (rGO) film in any pattern. Upon irradiation by blue light, some of these NPs turn into nanoblinker (AgO/Ag_n hybrid) exhibiting tricolored fluorescence intermittence. Most remarkably, the nanoblinkers formed on GO/rGO remain vibrant even after a period of 1 year, unlike other substrates studied. The hybrid material can also be used to detect Rhodamine B dye by changing the fluorescing colour of the Ag nanoblinkers upon interaction with dye. The shade of fluorescence and blinking rate of the nanoblinkers are highly dependent on the duration of interaction between the nanoblinkers and the Rhodamine B molecules. Furthermore, both the micro-patterns and tricoloured blinking behaviour are preserved upon their transfer from GO film onto other surfaces such as glass and PDMS film.

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Figure

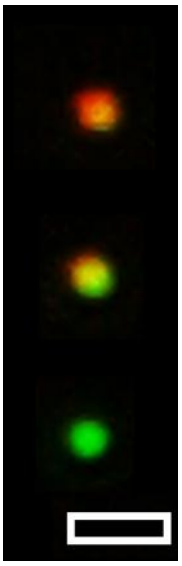

Figure 1: Tricoloured emission from an isolated blinker. The blinker randomly emit red, yellow or green colour or a combination of the colours. The emission source appears to be from the same spot in the sample. Scale bar: 1μm.