Graphene – silver nanoparticle interactions and their effect on Raman enhancement and transport properties

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Abstract (Arial 10)

The modulation of optical and electrical properties of ultrafine (~4 nm) Ag nanoparticle/graphene/SiO_2 hybrid material at low coverage is evaluated with gradual nanoparticle incorporation by the gas aggregation deposition technique.[1] The different contributing factors, such as doping, impurity scattering or strain, are assessed. Incorporation of Ag nanoparticles produce a very efficient n-type doping of graphene (~7.5 e^- per particle) maintaining the mobility constant for particle coverage below ~0.3 monolayers. Doping efficiency at further coverage is determined by the probability for nanoparticles to be deposited in contact with graphene. The Fermi level upshift is modeled within the charged impurity scattering mechanism in the whole coverage range. A crossover to the regime where impurity scattering dominates is evidenced at large particle concentration. Surface-enhanced Raman scattering is detected in graphene phonons for coverage as low as 0.08 that correspond to ~100 nanoparticles at the laser spot. Small distortions of the graphene lattice (±0.012 %) induced by the nanoparticles overcome the predicted changes in Raman phonons related to carrier doping and originate I_{2D}/I_G damping. This evolution of physical properties with gradual incorporation of Ag nanoparticles is anticipated to provide valuable hints to tune the optic and electronic performance of these graphene-based hybrid systems.

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References

[1] F. Jiménez-Villacorta, E. Climent-Pascual, R. Ramírez-Jiménez, J. Sánchez-Marcos, C. Prieto and A. de Andrés, *(submitted)*.