Nanosecond Optical Nonlinearity in Silver Decorated Graphene Oxide Nanohybrid Fabricated via Laser Ablation

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Unlike the traditional methods, herein, we report a laser-assisted green synthesis of silver nanoparticles that are anchored onto graphene oxide (GO) surface by a single step reaction via laser ablation using second & third harmonics of an Nd:YAG laser. Natural graphite powder was used to synthesize GO with modified Hummers' method [1]. The nonlinear optical properties of silver-nanoparticle decorated multilayered graphene oxide hybrid have been investigated in the nanosecond time scale by Z-scan technique. The enhancement in NLO properties in GO-Ag nanohybrid may be attributed to the complex energy band structures which promote resonant transition to the conduction band via surface Plasmon resonance (SPR) at low laser intensities and excited state transition (ESA) to the conduction band of GO at higher intensities [2, 3]. Along with it, the photo-generated charge carriers in the conduction band of silver or the increase in defect states during the formation of GO-Ag nanohybrid may contribute to ESA. Open aperture Z-scan measurement indicates reverse saturable absorption (RSA) [4] behavior of the synthesized nanohybrid which is a clear indication of its optical limiting (OL) ability.

References:

[1] Liu et al. Chem. Soc. Rev, **15**, p 5016−5030, (2015)
[2] Kumar et al. *Appl. Phys. Lett*, **95**, p 191911, (2009)
[3] Gu et al. *Appl. Phys. Lett*, **92**, p 091118, (2008)
[4] Lim et al. *Nat. Photon*, **5**, p 554, (2011)