Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **439** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Nonlinear optical properties of graphene: liquid-phase exfoliation vs chemical vapour deposition

Wednesday 9 June 2021 12:03 (4 minutes)

Liquid-phase exfoliation (LPE) is a low-cost and scalable technique for producing a wide range of van der Waals nanomaterials that can be incorporated into existing laboratory sample and industrial material production. Liquid-phase exfoliated nanomaterials have the potential to produce devices quickly and at low-cost, with colloidal dispersions easily adaptable to existing production methods. Other methods of nanomaterial production, such as chemical vapour deposition (CVD) and mechanical exfoliation can be costly, time-consuming and require complicated equipment to produce comparatively small area devices. Such methods are excellent for laboratory-scale samples to examine physical properties and produce proof of concept devices. However, LPE can and will bridge the gap towards real-world applications that require faster, easier and more cost-effective production methods. In this work, we investigate the saturable absorption and Kerr nonlinearity of graphene fabricated by LPE and CVD.

Thin films of LPE graphene were produced on BK7 glass substrates, and compared to CVD graphene transferred onto an identical substrate. Through careful consideration of the concentration of graphene dispersion and deposition methods, very thin films of graphene can be prepared. Atomic force microscopy (AFM) measurements showed effective bi-layer graphene thickness for the LPE samples. Z-scan measurements performed with 180 fs pulses at a wavelength of 1030 nm reveal that both LPE and CVD graphene display strong saturable absorption characteristics, with a nonlinear absorption coefficient (β) approaching -10⁴ cm/GW and a Kerr nonlinearity (*n2*) of -1 cm²/GW. Such strong saturable absorption is ideal for devices such as mode-lockers for ultrafast pulsed lasers. The magnitude of the nonlinear absorption coefficient of the LPE graphene increases with pulse duration, τ, up to 10⁵ cm/GW at around τ = 10 ps. These results pave the way for the use of LPE graphene in nonlinear optical applications such as frequency generation and mode locking.

Primary author: BAKER-MURRAY, Aidan (University of Ottawa)

Co-authors: COUTURE, Nicolas (University of Ottawa); Prof. MÉNARD, Jean-Michel (Department of Physics, University of Ottawa); SCARFE, Samantha (University of Ottawa); Prof. BLAU, Werner (Trinity College Dublin); PARK, Jaewoo (University of Ottawa)

Presenter: BAKER-MURRAY, Aidan (University of Ottawa)

Session Classification: W1-1 Photonics and Nano-Optics (DAMOPC) / Photonique et nano-optique (DPAMPC)

Track Classification: Atomic, Molecular and Optical Physics, Canada / Physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)