NUS National University of Singapore

Technology Licensing Opportunity

Saturable Absorber for Fiber Laser using Graphene-Ferroelectric Structures

Applications

Ultra-fast laser systems

Patents

Patent Pending

Opportunity

Exclusive/ non-exclusive licensing
Partnership in commercial development

Contact

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Advantages

- Ultrafast recovery time enables generation of ultrashort, energetic pulse
- Low power intensity input
- Can be saturated at any wavelength, i.e. wideband tunability - widest known modulation depth of all known saturable absorbers

Technology Overview

Saturable absorber is a critical component for ultrafast lasers which tunes the continuous wave output into a train of ultrafast optical pulses. The key requirements for saturable absorbers are its wavelength range (where it absorbs), its dynamic response (how fast it recovers), and its saturation intensity and fluence (at what intensity or pulse energy it saturates). They are commonly used for passive Q-switching.

Currently, the dominant technology is based on semiconductor saturable absorber mirrors (SESAMs). However, these have a narrow tuning range, and complex fabrication and packaging. Therefore, there is a need for tunable saturable absorbers with cheaper fabrication, lower power consumption and multi-wavelength operation for applications in ultra-fast laser systems.

The invention relates to the gate-tunable non-linear optical saturable absorber (SA) using ferroelectric polymer gated large-scale CVD graphene. The initial doping level of large-scale CVD graphene determines its performance as SA, which can be efficiently tuned by ferroelectric polymer gating, paving the way for the realization of ultra-short, low power consumption saturable absorber which is independent of incident wavelength.

The working principle of graphene based saturable absorber is illustrated in Figure 1 below. Graphene doped by ferroelectric polymer gating shows faster saturable absorption as compared to undoped graphene (Fig.2) and high optical transmittance (up to 95%) in the visible wavelength range. The doping level of the graphene-ferroelectric saturable absorber can be modified to tune the resonant wavelength of the saturable absorber.

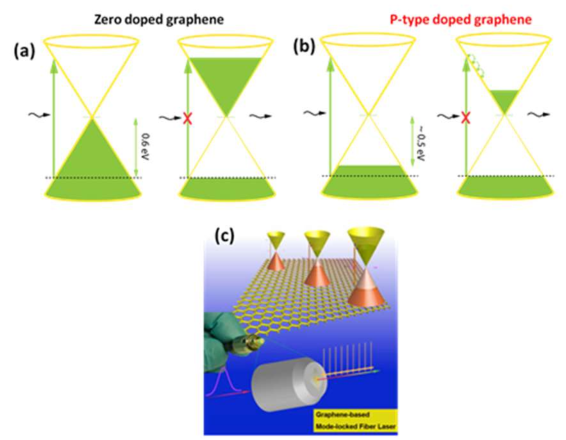

Fig.1: Schematic illustration of working principle of graphene-based saturable absorber. (a) The excitation process responsible for absorption of light in pristine graphene; the arrow indicates optical inter-band transition; at much higher excitation intensity, the photogenerated carriers cause the states near the edge of the conduction and valance bands to fill, blocking further absorption. (b) Excitation process responsible for absorption of light in heavily p-type doped graphene; due to the decrease of available excited electrons in the valence band, the required saturation intensity decrease dramatically. (c) Schematic diagram of graphene-based mode locker towards the low-power consumption high efficiency ultra-fast lasers.

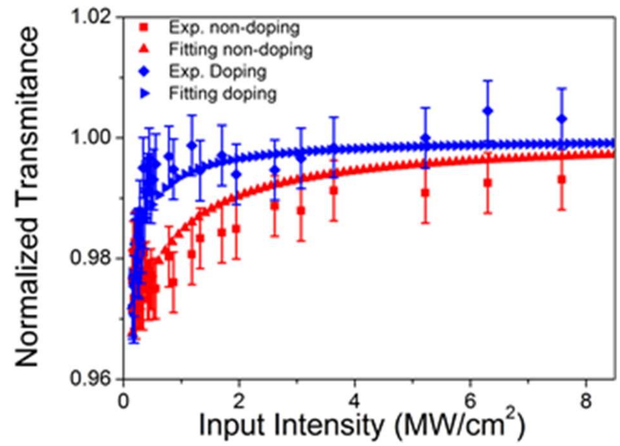

Fig.2: Non-linear optical absorption measurements show faster optical absorption saturation for doped graphene (graphene-ferroelectric) as compared to pristine graphene.

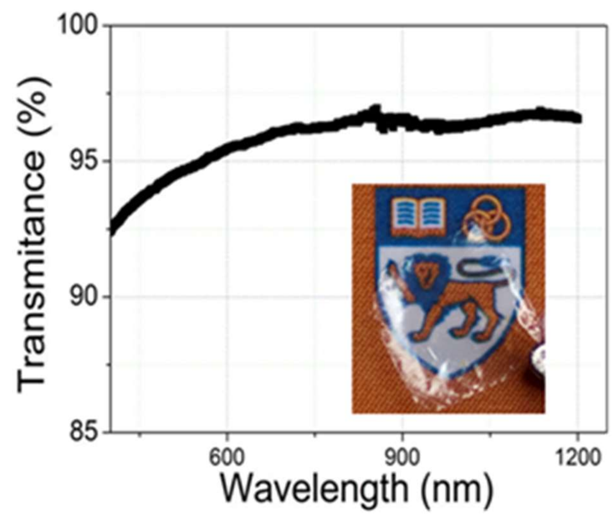

Fig.3: Optical transmittance of graphene-ferroelectric structure shows 95% optical transmittance at the visible wavelength range.