Graphene-based ultrafast broadband nonlinear photonics

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Graphene and graphene-based materials have been widely investigated for diverse applications in electronics, electro-optics and photonics. In particular, owing to very large optical nonlinearity with ultrafast response in broad spectral ranges, graphene provides application potential as broadband high-speed nonlinear modulators and switches. Saturable absorbers (SAs) are passive switching devices based on intensity-dependent optical nonlinearity. Q-switching and mode-locking by employing appropriate SAs are widely used techniques for short-pulse operation of diverse lasers. Compared to conventional SAs including widespread semiconductor saturable absorber mirrors (SESAMs) [1], graphene-based SAs exhibit superior advantages of ultrafast saturable absorption over ultrabroad spectral region, even far beyond 2000 nm without additional bandgap engineering [2-5].

In addition to graphene as broadband SAs for laser mode-locking and Q-switching, interesting nonlinear optical phenomena and characteristics are investigated in the THz frequency range. For example, THz nonlinearities of graphene can be remarkably accelerated by stacking disorder of monolayer graphene or in combination with meta- and nanogap-structures [6-8].

In this talk, universal use of graphene SAs for mode-locking and Q-switching of various lasers are reviewed. Furthermore, interesting features of graphene and graphene-based materials in the THz region will be also shown.

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