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GRAPHENE BASED MATERIALS FOR NON-LINEAR OPTICAL APPLICATIONS AND ULTRAFAST LASER APPLICATIONS AT 2 MICRONS

Abstract

In very recent years, graphene has become the focus of significant research efforts. Characteristics such as potential near-ballistic transport and high mobility make graphene viable as a material for nanoelectronics. Not only this, but its mechanical, electronic and thermal properties are also perfect for mirco- and nanoscale mechanical systems, thin film transistors, and transparent and conductive composites and electrodes. In this work, particular interest was afforded to the 2µm wavelength and to the modelocking capabilities of graphene, exploiting its optoelectronic properties to achieve this. Graphene is a prime candidate for several reasons, including its intrinsic broadband operation capabilities due to the gapless linear dispersion of Dirac electrons. Non-linear saturable absorption is required for materials used as a mode locker in lasers to obtain light pulses of very short duration, in the order of femtoseconds.

High yields of graphene were prepared via liquid-phase exfoliation of powdered graphite. As a comparison, dispersions and thin films of carbon nanotubes were also examined and their nonlinear optical properties compared with those of graphene.

Nonlinear optical properties are routinely examined using the so-called z-scan method. This set up consists of a thin sample being moved through the focus of a laser beam to vary the light intensity on the sample. This allows for measurement of the non-linear index n2 Kerr nonlinearity with the “closed” aperture method, and the non-linear absorption coefficient via the “open” aperture method.

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