Ultrafast optical Kerr effect method to study the Kerr nonlinearity of graphene

E. Dremetsika, B. Dlubak, S.-P. Gorza, C. Ciret, M.B. Martin, S. Hofmann, P. Seneor, D. Dolfi, S. Massar, Ph. Emplit, P. Kockaert

1.OPÉRA-photonique, Université libre de Bruxelles, Brussels, Belgium
2.Unité Mixte de Physique CNRS/Thales (UMR137), Palaiseau Cedex, France
3.Department of Engineering, University of Cambridge, Cambridge, United Kingdom

edremets@ulb.ac.be

Among its numerous interesting properties, graphene has a high and broadband optical nonlinearity [1], which has recently attracted a lot of interest, since graphene appears to be a promising material for integrated photonics [2]. Using the ultrafast optical Kerr effect method with optical heterodyne detection (OHD-OKE) [3], we have demonstrated that the nonlinear refractive index of graphene is negative[4], contrary to what was claimed before [5]. Compared to the previously-used Z-scan method, the OHD-OKE presents the major advantage to be robust against inhomogeneities of the sample. We studied both the real and the imaginary part of the third order optical nonlinearity, and by rotating the sample we managed to estimate the different components of the nonlinear susceptibility tensor, giving access to the nonlinearity, regardless if the optical field is in-plane or out-of-plane. This tensorial characterization of the optical nonlinearity, is a key step for the design of all-optical graphene-based devices.

References

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Figures

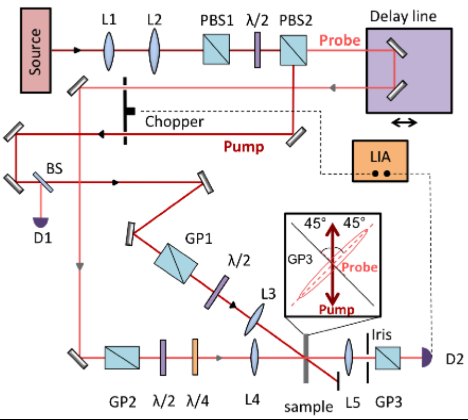

Figure 1: Experimental setup for the OHD-OKE method. The optical source delivers 180 fs pulses at 1600 nm. Inset: pump and probe polarization on the sample.

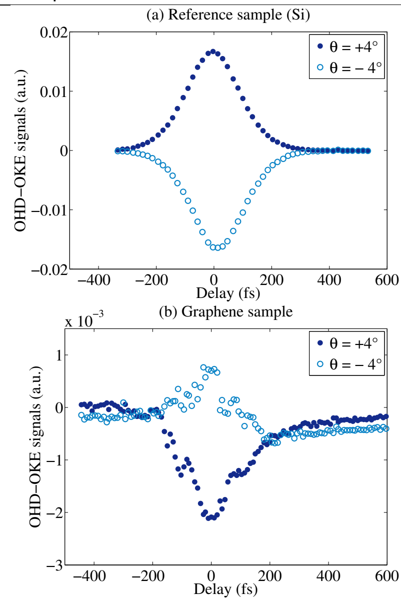

Figure 2: Experimental OHD-OKE signal from: (a) reference sample (Si) (b) monolayer CVD graphene on fused quartz. The curves in (a) and (b) present reversed signs.