Elliptically Polarized High-order Laser Harmonics in Hexagonal Graphene Quantum Dots

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There has been a growing interest in studying the optical nonlinear properties of solids through high harmonic generation (HHG) [1, 2]. The implementation of harmonics with elliptical or circular polarization is a rather complex problem, requiring special combinations of elliptical or circularly polarized pulses, and molecular alignment methods [3, 4]. In this work, we studied the transformation of light in a hexagonal graphene quantum dot (GQD) during the generation of high-order harmonics driven by intense laser field. At that, a linearly polarized laser field leads to intense emission of elliptically polarized harmonics. The degree of ellipticity and the orientation of the polarization ellipse calculated by Stokes parameters, are considering for various polarization components. Fig. 1 shows the dependence of the harmonic output intensity on the polarization angle θ of the linearly polarized EM wave for different harmonics; and the main axis of the harmonic polarization ellipse is already almost perpendicular to the polarization direction of the driving laser pulse from the 9th and higher harmonic. Numerical results show that the ellipticity of harmonics generated in GQD can be easily tuned by changing the tilt angle of a linearly polarized laser pulse without complex control systems. This research was supported by the Committee on Higher Education and Science of MESRA (research project No. 24WS-1C004).

References

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Figures

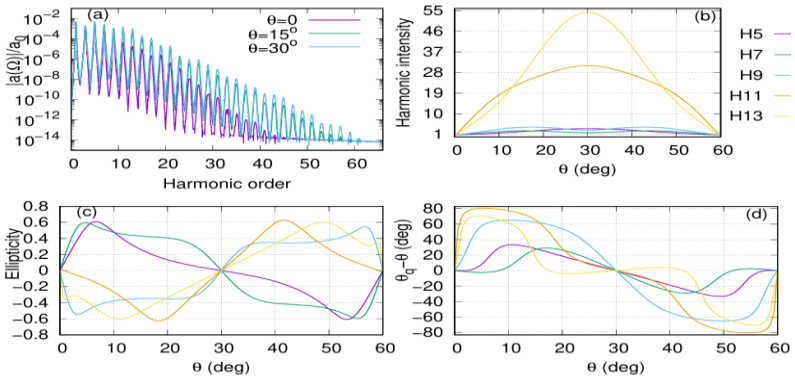

Figure 1: (a) Total yield of the HHG process in a 54-atom zigzag-edged hexagonal GQD in a linearly polarized laser pulse field for different tilt angles θ; the total yield for each angle we obtain by adding the spectral components of the Stokes parameters Sx, Sy. (b) Intensities of the emitted harmonics as a function of θ. (c) Ellipticity of the emitted harmonic as a function of θ; positive values of ellipticity indicate left-handed polarization. (d) Shift of the tilt angle θ_q-θ of the harmonic ellipse relative to the tilt angle θ of the laser field.