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Momentum resolved optical pump-probe spectroscopy in monolayer graphene: An analytical model and measurements MAXIM TRUSHIN, ALEXANDER GRUPP, GIANCARLO SOAVI, ARNE BUDWEG, University of Konstanz, Germany, DOMENICO DE FAZIO, ANTONIO LOMBARDO, UGO SASSI, ANDREA C. FERRARI, Cambridge Graphene Centre, University of Cambridge, UK, WOLFGANG BELZIG, ALFRED LEITENSTORFER, DANIELE BRIDA, University of Konstanz, Germany — Further development in graphene based photonics and optoelectronics requires fundamental information on the evolution of the strongly non-equilibrium charge carrier distribution created by the light-carrier interaction. Here, we report polarization and fluence dependent ultrafast optical pump-probe spectroscopy of high quality CVD-grown monolayer graphene. An analytical model has been developed and employed to describe the experiments. Graphene offers a unique opportunity to probe the photocarrier occupation, not only at different energies using a two-color setup, but also in different directions in momentum space applying linearly polarized beams. The latter approach is possible due to the pseudospin-momentum coupling which results in an optical pseudospin-selection rule. Our method allows us to quantify and control the relative contributions of both the strongly non-equilibrium anisotropic occupation and the hot Fermi-Dirac photocarrier distribution to the total differential transmission measured. We provide a conclusive and quantitative evidence for an anisotropic photocarrier occupation with a life-time of about 100 fs and claim that its relaxation towards the isotropic distribution occurs mostly due to optical phonon emission.

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