Photon helicity driven currents in graphene

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We report on the observation of photon helicity driven currents in graphene. We demonstrate that the illumination of unbiased monolayer graphene samples with terahertz (THz) laser radiation at room temperature under oblique and normal incidence causes directed electric currents. This includes currents which are solely driven by the light's helicity. In this case we observe a net electric current, whose sign reverses upon switching the radiation helicity from left- to right-handed circularly polarized light. The phenomenological and microscopic theories of the observed photocurrents are developed. We demonstrate that under oblique incidence the helicity driven current is caused by the circular ac Hall effect in the bulk of the graphene sheet driven by the crossed ac ***E***- and ***B***-fields of circularly polarized radiation [1]. Alike the classical dc Hall effect, the voltage is caused by crossed ***E***- and ***B***-fields which are, however, rotating with the light's frequency. By contrast, the effect observed at normal incidence stems from the sample edges, which reduce the symmetry and result in an asymmetric scattering of carriers driven by the radiation electric field [2]. The observation of a helicity driven photocurrent in graphene demonstrates that this material may be a good candidate for a novel type of detectors of THz radiation. Besides photon helicity dependent currents we also observe photocurrents driven by linearly polarized radiation. The microscopic mechanisms governing this effect are discussed.

References

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