Double resonant excitation of the second harmonic of terahertz radiation in dielectric-graphene layered metamaterials

Excitation of the second harmonic of THz radiation is investigated theoretically in the planar multilayered structure dielectric-graphene-dielectric-graphene–... It is studied the case of the oblique incidence of the s-polarized fundamental wave, where the electric field is parallel to the interfaces, and generation of the p-type second harmonic wave occurs. The original concept is proposed to employ the double resonance arrangement for the effective generation of the second harmonic. The double resonant case can be realized when a high-permittivity dielectric is at the input of the structure and the vacuum is at the output. The high efficiency is demonstrated; the second harmonic reflectance coefficient is ≥0.01 under realistic values of the collision frequency in graphene >1012 s−1. Such a great efficiency, which is four–five orders of magnitude higher than reported for the graphene-dielectric structures previously, is proposed for the first time. To compute the nonlinear surface currents, two approaches were used, the kinetic and the hydrodynamic. A qualitative agreement between two approaches, proven in the present modeling, ensures an applicability of the results.