Main principles of passive devises based on graphene and carbon films in microwave – THz frequency range

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Abstract:
The ability of thin conductive films, including graphene, pyrolytic carbon (PyC), graphitic PyC (GrPyC), graphene with graphitic islands (GrI), glassy carbon (GC), and sandwich structures made of all these materials separated by polymer slabs to absorb electromagnetic radiation in microwave-THz frequency range, is discussed. The main physical principles making a basis for high absorption ability of these heterostructures are explained both in the language of electromagnetic theory and using representation of equivalent electrical circuits. The idea of using carbonaceous thin films as the main working elements of passive radiofrequency (RF) devices, such as shields, filters, polarizers, collimators, is proposed theoretically and proved experimentally. The important advantage of PyC, GrI, GrPyC, and GC is that, in contrast to graphene, they either can be easily deposited onto a dielectric substrate or are strong enough to allow their transfer from the catalytic substrate without a shuttle polymer layer. This opens a new avenue toward the development of a scalable protocol for cost-efficient production of ultralight electromagnetic shields that can be transferred to commercial applications. A robust design via finite-element method and design of experiment for RF devices based on carbon/graphene films and sandwiches is also discussed in the context of virtual prototyping.

Keywords:
Absorption, Electromagnetic shielding, Filter, Graphene, Robust design, Thin film, Electronic, Optical and Magnetic Materials, Condensed Matter Physics