

Recent Advancements of Graphene-based Metasurfaces in Terahertz Frequencies

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Since the invention of graphene, a huge number of researches have been carried out all over the world due to its interesting thermal and electrical properties. Graphene supports surface plasmons in the lower terahertz frequencies and mid-infrared (MIR) region, unlike the noble metals supporting plasmons in the visible spectrum. The surface conductivity of graphene is dependent on the Fermi energy (E_f) and it can be modulated under the influence of the external factors, viz., chemical doping, electrical biasing, or mechanical stretching. The idea of studying graphene metasurface for electromagnetic (EM) applications in the THz frequency region is tempting because of its tunable and broadband spectral response. Metallic metasurfaces suffer from an unwanted correlation between amplitude and phase manipulation in optical systems as one meta-atom can produce one resonance condition only. Contrarily, graphene metasurface can offer the tunable property in conductivity response. After that, the graphene meta-atoms can exhibit multiple resonance conditions from a single structural configuration, which enables them to achieve the complete control of the wavefront. Research works on millimeter (mm) wave, and higher frequency bands have been explored to study the growth of demand for data to pave the way toward 5G/6G communication systems. To allow higher data rates, improved physical security, and avoid EM interference, research works toward optical wireless communication have been potentially increased nowadays. Avoiding EM interference is an important integral part of electromagnetic compatibility. Terahertz gap (0.1–10 THz) can serve as a bridge between mm-wave and optical spectrum where naturally available materials cannot be used as they suffer from high loss.

A few prototypes have been designed to investigate the EM applications of the graphene metasurface. Simulation and theoretical studies have been conducted to design several structures like absorbers, filters, polarization converters, antennas etc. as shown in Figure 1.

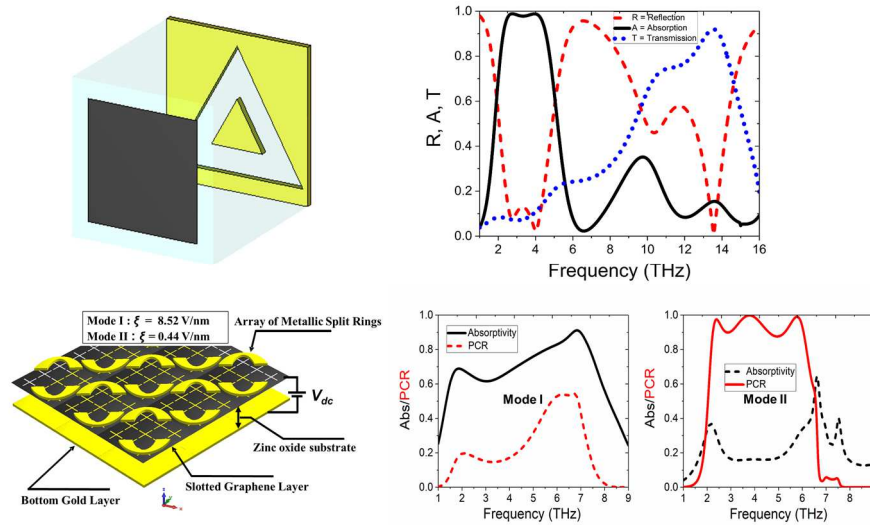


Figure 1. Graphene-based metasurfaces for absorber and dual-functional applications.

References

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