Ultrasensitive Terahertz Waveguide Modulators Using Multilayer Graphene Metamaterials

We study terahertz-infrared electromagnetic properties of multilayer graphene-dielectric metamaterial and present novel waveguide-based devices: modulators with high modulation depth (> 38 dB at 0.07 eV graphene’s Fermi energy change) or extreme sensitivity (modulation depth of > 13.2 dB at 0.001 eV Fermi energy variation), and tunable passband filters (10% central frequency shift per 0.004 eV Fermi energy change).