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Controlling Terahertz Waves using Graphene Supercapacitors

NURBEK KAKENOV, OSMAN BALCI, EMRE O. POLAT, Bilkent University, HAKAN ALTAN, Middle East Technical University, COSKUN KOCABAS, Bilkent University — Ability to control density of high mobility charge carriers on graphene provides a unique platform to control electromagnetic waves in a broad spectrum. In this work, we demonstrate a terahertz intensity modulator using a graphene supercapacitor which consists of two large area graphene electrodes and electrolyte medium. This simple device structure enables us to modulate THz waves in a broad spectrum without any metallic gate electrodes. The mutual electrolyte gating between the graphene electrodes provides a very efficient electrostatic doping with Fermi energies of 1 eV. We show that, the graphene supercapacitor yield more than 50% modulation between 0.1 to 1.4 THz with operation voltages less than 3V. The low insertion losses, the simplicity of the device structure and polarization independent device performance are the key attributes of graphene supercapacitors for THz applications.

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