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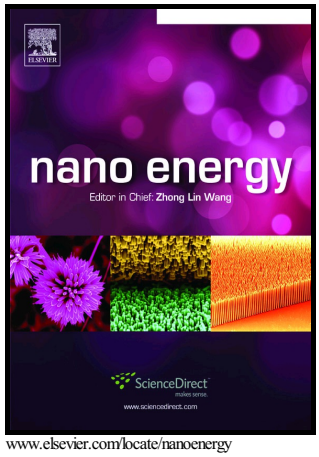

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Intrinsic rectification in common-gated graphene field-effect transistors

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Abstract

Terahertz rectifying antennas (rectennas) couple micron-size antennas and high-speed diodes to convert the incident electro-magnetic radiation to useable DC power. At such frequencies, the device acting as the diode requires both a nonlinear electrical behavior and a very low parasitic capacitance. Due to their low-capacitance planar structure and high carrier mobility values, several graphene devices based on various rectification mechanisms have been previously proposed as the rectifying device in the terahertz range. In this paper, we report an asymmetric behavior in micrometer-scale rectangular CVD-grown graphene field-effect transistors (GFETs), both at 77 K and room temperature (295 K). The asymmetry with a measured I_{ON}/I_{OFF} ratio as high as 1.85 is shown to originate from the slight change in graphene conductivity induced by drain-gate voltage variations. This is confirmed by simulations using a simple drift-diffusion transport model. The conclusions can be directly applied to optimize diode-connected GFETs. This nonlinear effect may also be of interest for graphene interconnect considerations as well as circuit designs using GFETs.

Keywords: AC-DC power converters, Energy harvesting, Rectifier, Rectenna, Diode, Graphene.

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