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标题: Terahertz Imaging and Time-Domain Spectroscopy of Large-Area Graphene on Silicon
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摘要: We demonstrate THz imaging and time-domain spectroscopy of a single-layer graphene film. The large-area graphene was grown by chemical vapor deposition on Cu-foil and subsequently transferred to a Si substrate. We took a transmission image of the graphene/Si sample measured by a Si: bolometer (pixel size is 0.4-mm). The graphene film (transmission: 36 - 41%) is clearly resolved against the background of the Si substrate (average transmission: 56.6%). The strong THz absorption by the graphene layer indicates that THz carrier dynamics are dominated by intraband transitions. A theoretical analysis based on the Fresnel coefficients for a metallic thin film shows that the local sheet resistance varies across the sample from 420 to 590 Ohm, consistent with electron mobility similar to 3,000 cm(2)V(-1)s(-1). We also measured time-resolved THz waveforms through the Si substrate and the graphene/Si sample. The waveforms consist of a series of single-cycle THz pulses: a directly transmitted pulse, then subsequent "echos" corresponding to multiple reflections from the substrate. The amplitude difference between graphene/Si pulses and Si pulses becomes more pronounced as the pulses undergo more reflections. From these measurements, we obtained spectrally flat transmission spectra of the transmitted pulses and the average sheet resistance 480 Ohm, consistent with the results of the power transmission measurement. The flat spectral responses indicate that the carrier scattering time in our graphene sample is much shorter than the THz pulse duration.
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