High-Speed and integrated graphene blackbody emitters

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Nanocarbon-based optoelectronic devices are promising candidates for the high-speed, uncooled and on-chip optical communication devices [1-3]. Here, we report highly integrated, high-speed blackbody emitters based on graphene in near-infrared region including telecommunication wavelength and these application to optical communications [4].

We fabricated blackbody emitters with single-layer, few-layer and multi-layer graphene. By applying bias voltage to these devices, we heated graphene by Joule heating and obtained light emission following Planck's law in near-infrared region including telecommunication wavelength. Under a rectangular voltage, a fast response time of ~ 100 ps, corresponding to ~ 10 GHz modulation, has been experimentally demonstrated for single and few-layer graphene. Their emission responses are strongly affected by the graphene contact with the substrate depending on the number of graphene layers. The ultra-high-speed emission can be understood by remote quantum thermal transport via surface polar phonons of the substrates. We also confirmed by time resolved measurement that these graphene light sources can emit optical pulse with full width at half maximum of 200 ps. We also demonstrated real-time optical communications, integrated two-dimensional array emitters, capped emitters operable in air, and the direct coupling of optical fibers to the emitters. These results indicates that the graphene light source is a new candidate for high speed light source for on silicon-chip optical communication.

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