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Tunable plasmonic emission of radiation in graphene

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Materials at finite temperatures emit electromagnetic radiation due to the thermally induced motion of particles and quasi-particles. The radiated power is dictated by the electromagnetic energy density and emissivity, which are ordinarily fixed properties of the material and temperature. Recent experiments have shown, however, that the emissivity of a material may be modified through surface patterning to allow for thermal radiation that is coherent, unidirectional and spectrally narrow. We show that electronically tunable, dynamic control of emissivity can be achieved in blackbody radiators whose surface is coated with a thin layer of variable emissivity. Specifically, we experimentally demonstrate tunable electronic control of blackbody emission from graphene plasmonic resonators on a silicon nitride substrate at temperatures up to 250° C. We show that the graphene resonators produce antenna-coupled blackbody radiation, manifest as narrow spectral emission peaks in the mid-IR. By continuously varying the nanoresonator carrier density, the frequency and intensity of these spectral features can be modulated via an electrostatic gate. We describe these phenomena as plasmonically enhanced radiative emission originating from loss channels associated with both plasmon decay in the graphene sheet and from vibrational modes in the SiN_x. This work opens the door for future devices that may control blackbody radiation at timescales beyond the limits of conventional thermo-optic modulation.