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Ultra-sensitive thermal measurements of graphene: pathway to single microwave photon detector KIN CHUNG FONG, KEITH SCHWAB, Caltech — As a result of the linear energy spectrum and low dimensionality, electrons in graphene have astoundingly small thermal conductance and heat capacitance. By developing a large bandwidth, high sensitivity Johnson noise measurement technique at microwave frequency, we can measure the temperature of graphene electrons down to a precision of 0.1 mK within 1 second. This enables us to study the thermal properties of this wonder material: for instance, we have measured the energy transfer from electrons to phonons at 1 pW/K μm^2 level and a record-low heat capacity, only about 100 kB/μm^2, at low temperature. We have applied these exotic thermal quantities to make a graphene bolometer and mixer. Our measurement data agree well with the theory that the proposed graphene caloriometer should have single photon sensitivity from IR down to microwave regime at ultra-low temperature.

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