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Thermal Properties of Graphene

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Graphene is known to possess excellent thermal properties, including high thermal conductivity, that make it a prime candidate material for heat management in ultra large scale integrated circuits. For device applications, the key parameters are the thermal expansion coefficient and the thermal conductivity. There has been no reliable experimental determination on the thermal expansion coefficient of graphene whereas the estimates of the thermal conductivity vary widely. In this work, we estimate the thermal expansion coefficient of graphene on silicon dioxide by measuring the temperature dependence of the Raman spectrum. The shift of the Raman peaks due to heating or cooling results from both the intrinsic temperature dependence of the Raman spectrum of graphene and the strain on the graphene film due to the thermal expansion mismatch with silicon dioxide. By carefully comparing the experimental data against theoretical calculations, it is possible to determine the thermal expansion coefficient. The thermal conductivity is measured by estimating the thermal profile of a graphene film suspended over a circular hole of the substrate.

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