Dual-mode Raman method to measure thermal transport properties of 2D materials and van der Waals heterostructures

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This paper presents a dual-mode Raman method for comprehensively measuring in-plane and interfacial thermophysical properties of 2D materials and layered van der Waals heterostructures. The term "dual-mode" refers to employing both continuous-wave (CW) laser with variable spot sizes and pulsed laser with variable pulse durations to heat the sample. With no need of knowing laser absorption, the in-plane thermal conductivity and interfacial thermal conductance can be analytically extracted from the multiple Raman-measured temperature curves of each 2D layer as a function of laser spot radius, while the thermal diffusivity of each layer can be extracted from the transient temperature curves as a function of pulse durations. Three-dimensional transient heat conduction models were analytically solved for 2D materials and *n*-layer van der Waals heterostructures in both suspended and supported geometries. Then I successfully used this dual-mode Raman method to measure both thermal conductivity and thermal diffusivity of graphene samples in both suspended and supported geometries, and also measured the interfacial thermal conductance in the CVD-grown MoS_2/WS_2 heterostructure. The measurement method presented here is useful for investigating thermal transport in the emerging variety of 2D materials.