Tuning Thermal Conductance Across Two-dimensional Layered van der Waals Materials via Interfacial Mismatch and Coupling Engineering

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The understanding of heat flow across solid interfaces and its control are extremely important for the applications of advanced electronics, thermal energy conversion, and thermal managements in devices. Two-dimensional (2D) material family with ultrathin thickness as a new rising star makes it possible to tune the thermal property at atomic-scale. [1] For instance, the stacking structure of graphene, MoS_2, and WSe_2 shows extremely high thermal isolator property on a sub-2-nm scale [2], and disordered WSe_2 exhibited very low thermal conductivity[3]. Therefore, experimental understanding on the heat flow across the 2D interfaces is of great importance. Here, we provide a PEG-assistant TDTR method to evaluate thermal conductance (TC) of atomic-scale-thin materials with improved sensitivity. The TC of a series of 2D vdW materials has been investigated, in which $MoSe_2$-MoS_2-$MoSe_2$-MoS_2 heterostructure demonstrates the lowest TC, which is one order of magnitude lower than air at room temperature. The interfacial mismatch and interfacial coupling effect are two main factors to tune TC for 2D-layered vdW materials.

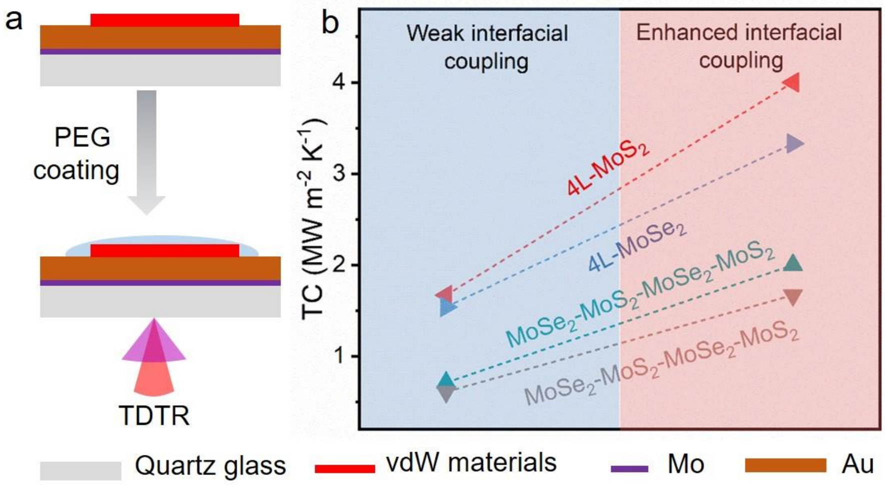

Figure 1. (a) Schematic for the PEG-assistant TDTR method. (b) the TC of these layered vdW materials and the effects of interfacial coupling on TC.

References

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