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Interfacial Heat Transport in Semiconducting Heterostructures

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Abstract

Heat dissipation through semiconducting heterostructures is of technological importance and fundamental research interest. Diamond is a desirable heat spreader, for integrating with semiconductors to dissipate quickly large amount of heat generated in electronics. The rapid development of GaN-on-diamond devices holds much promise for thermal management of high-power electronics and devices. Hitherto, the interfacial effect of an inherent epilayer between GaN and diamond to thermal dissipation is less investigated. One aim of this study is to understand and analyze the interfacial thermal boundary resistance (TBR) across a diamond/GaN heterostructure with an epilayer of different substrates. The thickness effect of epilayer is also revealed. Besides, c-BN is drawing increasing attention because it not only owns diamond-like thermal properties but also is a promising material for fabricating optoelectronic devices. It was found that the interfacial TBR reduced when the diamond cap or the GaN substrate was replaced by the c-BN. Further, c-BN can be directly grown on diamond without use of epilayer, resulting in an unprecedented low TBR in the diamond/c-BN interface.