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**Potential of layered materials for thermionic devices: a first-principles study<sup>1</sup>**

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Solid-state heat to electrical energy conversion is usually done by using thermoelectric materials, which are thought to perform better than thermionic devices. Here, we would like to show that layered materials which are usually bonded by van der Waals interactions, have considerable potential to be used for cooling or heat to electrical energy conversion, of performance comparable to thermoelectrics. This claim is backed by first-principles calculations. The reason for this good performance is the low cross-plane thermal conductivity of these materials due to their weak bonding. Furthermore, the energy barrier for electrons to cross the device can be relatively easily tuned because of the large choice of layered materials of various band gaps and the variation of the bandgap with the number of layers. This implies that the device performance can easily be optimized.

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