Theoretical thermal rectification in Si and Ge thin films

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A deep understanding of heat transport in low-dimensional semiconductor structures is a topic of increasing research activities driven by the need for a more energy conscious society. This is motivated, in part, by the increasing importance of thermal management as a consequence of the large power densities resulting from the continuous miniaturization of electronics components. In this sense, the thermal rectification at nano/microscale is attracting an increasing scientific attention due to its promising potential for thermal management and energy efficiency. Moreover, in analogy with the electrical diode, the thermal rectifier or diode becomes an essential building block of thermal logic circuits.

In the present work, the different temperature dependence of the thermal conductivity between two materials is studied for thermal rectification. Four different combinations of silicon and germanium films had been studying. Thermal conductivities are calculated using Fuchs-Sondheimer boundary corrections. The theoretical predictions suggest values of 0.5 to 10 % of efficiency in Si-Si and 0.4 to 12 % in Si-Ge systems [1].

References

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