Thermal rectification in inhomogeneous nanotubes

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Abstract

Heat transfer in axially inhomogeneous nanotubes is known to be asymmetric with respect to the direction of transfer. This phenomenon is known as the thermal rectification. We demonstrate that thermal rectification in such nanotubes arises due to the interference of phonons excited in the different parts of the nanotube. It is shown that the rectification does not vanish when the thickness of nanotube increases, but it vanishes as the external diameter of nanotubes decreases to a few nanometers. The understanding of the origin of thermal rectification opens a way to the design of devices controlling heat flows that could perform as efficiently as their electronic counterparts controlling electric currents.