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OMNIDIRECTIONAL HEAT MIRROR ON ONE-DIMENSIONAL POROUS SILICON

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We have designed a thermocrystal with band gaps which reflects phononic thermal radiation. In the THz range, heat is kinetic energy carried predominantly by phononic vibrations with wavelengths that allow multiple reflections on the internal interfaces of a nanometric phononic crystal. We found the conditions to obtain band gaps for longitudinal and transversal waves simultaneously. We propose a structure with omnidirectional mirror for phononic vibrations which might reduce the heat flow significantly.

A vital point of this approach is to switch how the thermal transmission is analyzed. Instead of using the traditional approach based on a flow of phonons as particles, we adopt the treatment of phonons as waves. If phonons have wavelengths on the order of period, multiple reflections are possible within the crystalline structure. This interference phenomenon gives rise to the existence of band gaps, opening new possibilities to control heat. The ability to manipulate thermal transport via wave effects is of interest in technological applications, as an example, to achieve an efficient thermoelectric energy conversion.