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Phonon transmission and reflection antiresonances at the interface between solids with impurities as interference phenomena in atomic-scale phononic metamaterials YURY KOSEVICH, HAOXUE HAN, SEBASTIAN VOLZ, Laboratoire d'Energetique, Moleculaire, Macroscopic et Combustion, CNRS UPR 288, Ecole Centrale Paris — We study theoretically phonon transmission through the interface between two solid crystals, which contains heavy isotopic impurities and/or soft-force-constant defects. We perform analytical calculations of plane wave transmission and numerical molecular dynamics simulation of wave packet transmission, which give consistent with each other results. If the impurities do not fill completely the interface plane, longitudinal and transverse phonons have two passes to cross such interface, through the host and through the impurity atoms bonds. Destructive interference between these passes can result in total resonance reflection of the phonon. The phonon transmission antiresonance is followed by phonon reflection antiresonance at higher frequency. The random distribution of the defects at the interface and nonlinearity of atomic bonds do not deteriorate the reflection and transmission antiresonances. Such Fano-like phonon interference antiresonances can affect heat transport through interfaces and contacts between nanostructures with impurities. The antiresonances are realized in phonon transmission through a planar defect in Si crystal with segregated Ge atoms. The phonon antiresonances can be considered as interference phenomena in atomic-scale phononic metamaterials.

Yury Kosevich
Laboratoire d'Energetique, Moleculaire, Macroscopic et Combustion,
CNRS UPR 288, Ecole Centrale Paris

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