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标题: Ultrafast dynamics of coherent optical phonons in GeTe/Sb2Te3 superlattices: Thermal conductivity and coherent control
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摘要: We report on the evaluation of lattice thermal conductivity of GeTe/Sb2Te3 superlattice (SL) by using a coherent phonon spectroscopy at various lattice temperatures. The time-resolved transient reflectivity obtained in amorphous and crystalline GeTe/Sb2Te3 SL films exhibits the coherent A(1) optical modes at terahertz (THz) frequencies with picoseconds dephasing time. The relaxation time and frequency of the coherent A(1) modes are used to compute the lattice thermal conductivity based on the Debye theory, including scattering by grain boundary and point defect, umklapp process, and phonon resonant scattering. The results indicate that the thermal conductivity in the amorphous SL film is less temperature dependent, due to the dominant phonon-defect scattering, while in the crystalline SL it is temperature dependent because of the main contributions from umklapp and phonon resonant scatterings. We argue the higher thermal conductivity in the GeTe/Sb2Te3 SL films than that in the Ge2Sb2Te5 alloy films implies that the phase change in GeTe/Sb2Te3 SL is not purely promoted by thermal process, i.e., lattice heating, but rather by nonthermal process, i.e., coherent lattice excitation, because the thermal process generally requires lower thermal conductivity.
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