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Title: A GaAs/AlAs superlattice as an electrically pumped THz acoustic phonon amplifier

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Abstract:In a semiconductor superlattice (SL), phonon-assisted electron transitions can occur under a quasi-population inversion, brought about by electrical biasing. This paper demonstrates the amplification of an optically excited quasi-monochromatic phonon beam by stimulated emission of phonons. Coherent phonons are generated by ultrafast optical excitation of a generator SL and passed once through a dc biased, GaAs/AlAs gain SL. A 20% increase in the phonon flux is detected when pumping is applied to the gain superlattice, which corresponds to an acoustic gain coefficient of 3600 cm?1. A theoretical model of the phonon amplification is presented that also includes the effects of disorder in the SL. It is found that the amplification process is robust in the presence of disorder and good agreement is obtained with the main features of the experimental observations. © IOP Publishing Ltd and Deutsche Physikalische Gesellschaft.