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Monochromatic high frequency coherent phonons propagation with superlattice transducers

Agnès Huynh[a], Maria Florencia Pascual Winter[a], Bernard Perrin[a,b], Bernard Jusserand[a], Aristide Lemaitre[c] and Alejandro Fainstein[d]
[a]INSP - UMR 7588 CNRS & Université Pierre et Marie Curie, 140 Rue de Lourmel, 75015 Paris, France
[b]Laboratoire des Milieux Désordonnés et Hétérogènes, Université Pierre et Marie Curie, UMR 7603 CNRS, 4 Place Jussieu, 75252 Paris, France
[c]LPN, CNRS route de Nozay, 91460 Marcoussis, France
[d]Centro Atomico Bariloche & Instituto Balseiro, C. N. E. A., 8400 S. C. de Bariloche, Argentina

The availability of efficient and compact phonons transducers in the THz range would be very interesting for phonons spectroscopy, acoustic microscopy and study of vibrational and electronic properties of nanostructures. Thanks to epitaxial growth of semiconductors multilayers, high quality phononic nanostructures with standard semiconductors, such as superlattices (SL) and nanocavities can be obtained for the GHz and THz transduction. Picosecond ultrasonics experiments have been performed in transmission geometry with pump and probe incident on opposite sides of the substrate, allowing discoupling acoustic generation and detection processes. By these means, we have shown independently that SL are very efficient high frequency monochromatic phonon generators and detectors. We report on experiments where two superlattices have been grown on the opposite sides of a substrate: a first SL with uniform layer thickness over the whole surface sample is used as a generator; the other one, used as the detector, presents a thickness gradient and the location of the detection is chosen in order to have the best matching with the emitted frequency. This setup is used to study the propagation of monochromatic high frequency coherent phonons as a function of temperature.