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Photoelastic transduction in photo-phononic nanodevices

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

We will discuss the new possibilities that semiconductor superlattices and acoustic nanocavities open for the controlled manipulation of quasi-monochromatic acoustic waves in the terahertz range. Playing with the specific electronic properties of quantum wells constituting acoustic nanodevices allows to selectively generate or detect phonons with a specific spatial distribution of the deformation along the acoustic device propagation axis. We could for instance demonstrate the selective generation of cavity phonons at resonance with cavity excitonic transitions or the increased photoelastic coupling of folded acoustic modes in mirrors when the number of nodes of the acoustic mode coincide with the one of the dominantly resonant excitonic transition. We also used the combination of photonic and phononic cavities to ensure phase matching with cavity phonons in the standard detection scheme corresponding to transient reflectivity in the time domain or Raman backscattering in the frequency domain. Photonic cavities moreover provide a strong increase of the internal optical fields by quality factors up to 100 typically, resulting in high enhancements of the transduction efficiency of monochromatic phonons to the benefit of the envisioned high speed modulation of optoelectronic properties of coupled photo-phononic nanodevices.