Impact of nanophononics on thermoelectricity: measurements and methods

Olivier Bourgeois, Christophe Blanc, Hossein Ftouni, Dimitri Taïnoff
Institut Néel, Université Joseph Fourier-CNRS, 25 rue des Martyrs, BP 166, 38042 Grenoble Cedex 9, France

We will review recent progresses made in nanophononics to get a better approach in energy harvesting [1,2]. The manipulation of phonons in low dimensional suspended structures opens up very important questions especially at low temperature [3,4]. Different concepts have been proposed to transform single crystalline materials into phonon glasses: phononic crystals, suspended structured membranes, nanoengineered materials. The possible reduction of phonon transport in these structures by opening a gap in the dispersion relation, by reducing the group velocities or by decreasing the phonon mean free path is a possible path towards better thermoelectrics.

The measurement of very small suspended systems requires the development of highly sensitive experimental techniques. We will describe state of the art experimental methods that have been proposed for the measurement of tiny energy exchange from room temperature to very low temperature [5] (thermal conductance measurement and heat exchange in general). We will show recent experiments that play with phonons at the nanoscale. To conclude we will see that nanophononics at low temperature is still a very open subject especially with suspended systems containing electrons like graphene or two dimensional electron gas.

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[2] J. Tang et al. *Holey Silicon as an Efficient Thermoelectric Material*, Nano Letters **10**, 4279 (2010)
[3] J-S. Heron, C. Bera, T. Fournier, N. Mingo, and O. Bourgeois, *Blocking phonons via nanoscale geometrical design*, Phys. Rev. B **82**, 155458 (2010).
[4] Christophe Blanc, Ali Rajabpour, Sebastian Volz, Thierry Fournier, and Olivier Bourgeois *Phonon Glass Behaviour in Corrugated Silicon Nanowires Due to Phonon Backscattering*. (2012)
[5] A. Sikora, H. Ftouni, J. Richard, C. Hébert, D. Eon, F. Omnès, and O. Bourgeois, *Highly sensitive thermal conductivity measurements of suspended membranes (SiN and diamond) using a 3ω-Völklein method*. Rev. Sci. Instrum. **83**, 054902 (2012).