Centre DE Nanosciences & DE Nanotechnologies

C2N Seminar

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"Some key issues to model and characterize thermoelectric devices"

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Thermoelectricity has attracted the interest of the scientific community since its first observation by Thomas Seebeck in 1823. As a prototype of the most recent developments in finite-time thermodynamics, driven by the non-equilibrium thermodynamics formulated by Onsager (1931), thermoelectricity is of dual interest, both in fundamental and applied terms. In recent years, thermoelectricity has been the subject of major research efforts in the context of energy harvesting, aiming at direct conversion of heat into electricity using new non-toxic materials offering increased efficiency.

Beyond the interest of new materials for such a conversion, it is important to consider how to use these devices. First, the thermal contact between the device and the heat reservoirs is one of the key parameters that must be taken into account. In a first part, the impact of thermal contacts with the reservoirs will be described in order to extract the maximum power from the system [1]. The key relationship between irreversibility and efficiency at maximum power can then be derived [2]. The second issue concerns the ability to fully characterize thermoelectric materials and devices. To this end, recent advances in the use of nonlinear harmonic response will be illustrated for a standard thermoelectric system [3].

References:

[1] Y. Apertet, H. Ouerdane, O. Glavatskaya, C. Goupil, and Ph. Lecoeur "Optimal working conditions for thermoelectric generators with realistic thermal coupling". Europhysics Letters vol. 97, 28001 (2012).

[2] H. Ouerdane, Y. Apertet, C. Goupil, and Ph. Lecoeur "Continuity and boundary conditions in thermodynamics: From Carnot's efficiency to efficiencies at maximum power". European Physical Journal -- Special Topics vol. 224, 839 (2015).

[3] E. Thiébaut, F. Pesty, C. Goupil, G. Guegan, P. Lecoeur, Non-linear impedance spectroscopy for complete thermoelectric characterization: Beyond the zT estimation.Journal of Applied Physics 124 (23), 235106 (2018)

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