

MAP-fis Essay Proposal, 2015-2016

(please write in English)

Supervisor

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Title

New Nanogenerators for Thermal Energy Harvesting

Area

(Materials, Optics, Condensed Theory, High Energy Theory,...);

Nanotechnology, Energy Harvesting, Engineering Physics, Materials Science,

Summary of Proposal

The continuous energy demand is causing an escalation of social and political unrest. In the XXIth century, large efforts are being made towards a new energy paradigm grounded in vectors such as energy saving and alternative production/recovery methods: the so-called Energy Harvesting. Several strategies are being used to scavenge the energy ranging from solar, vibration, magnetism, radio frequency and thermoelectricity. This project falls on the domain of thermal energy conversion into electricity using two distinct physical phenomena: Thermoelectricity (Peltier Effect) [1] and the recently discovered Spin Seebeck Effect (SSE) [2].

The main goals of the present project are:

- Low-cost and efficient flexible thermoelectric technology for low temperature working operation conditions (<300 °C) and rigid devices for high temperatures (up to 600 °C) [3].
- New scalable process for fabrication of flexible thermoelectric generators using nanoparticle-based solutions compatible with high throughput printing techniques (flat-bed screen-printing and rotary screen).
- Innovative heat harvesting devices using the SSE [4].
- New cell architectures based on the implementation of nanostructured thermoelectric devices.

This proposal is framed within the scope of the project PTDC/CTM-NAN/5414/2014 involving a strong multidisciplinary between Universities, Center for Technological Transfer and Industrial

partners.

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References

(to allow students first look at topic)

- [1] G.J. Snyder, E.S. Toberer, “Complex thermoelectric materials” *Nature Materials*, 7, 105-114 (2008).
- [2] K. Uchida, S. Takahashi, K. Harii, J. Ieda, W. Koshibae, K. Ando, S. Maekawa & E.Saitoh “Observation of the spin Seebeck effect” *Nature* 455, 778-781 (2008).
- [3] D. Liang, H. Yang, Scott W. Finerock, and Yue Wu, “Flexible Nanocrystal Coated Glass Fibers for High-Performance Thermoelectric Energy Harvesting” *Nano Lett.*, Articles ASAP (2012).
- [4] E. Gerrit E. W. Bauer, E. Saitoh and B.J.V. Wees, “Spin caloritronics” *Nature Materials* 11, 391–399 (2012).