MAP-fis Essay Proposal, 2015-2016

(*please write in English*)

Supervisor

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Title

Strain Coupled Nanofibers by Electrospinning

Area

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

Materials

Summary of Proposal

The main objective is to develop artificial cilia transducers based on selected combinations of piezoelectric and magnetostrictive materials, to form elastically coupled multiferroic [1,2] magnetoelectric artificial cilia. Artificial cilia are micro sensors/actuators, which mimic the structure and function of their natural counterparts [3]. They can be used for the detection of acoustic, fluid flow, tactile inputs, magnetic fields or other stimuli. The aim is to produce high aspect ratio core-shell nanofibers by electrospinning with long lengths and diameters in the nanometer range. By using the electrospinning technique [4,5], the control of the size and orientation distributions of the nanosized structures can be attained without the use of expensive lithography setups. These magneto-electric cilia transducers have the advantage of integrating different sensing capabilities (acoustic (strain), magnetic, electric) on a single structure and directly converting the induced stimulus in a voltage signal, through the piezoelectric effect and the magnetoelectric coupling between both phases.

The objective of this essay e to make a review of nanofibers synthesis by electrospinnig, with a focus on ferroelectric and ferromagnetic nanofibers, as well the main techniques for their structural, morphological, magnetic and electric characterizations.

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References

(*to allow students first look at topic*)

[1] W. Eerenstein, N. D. Mathur, J. F. Scott, "Multiferroic and magnetoelectric materials", Nature, 442, 759 (2006)

[2] B. A. Evans, A. R. Shields, R. Lloyd Carroll, S. Washburn, M. R. Falvo, R. Superfine, "Magnetically Actuated Nanorod Arrays as Biomimetic Cilia", Nano Letters, 7, 1428-1434 (2007)

[3] J. F. Scott, "Applications of magnetoelectrics", J. Mater. Chem., 22, 4567-4574 (2012)

[4] P Sa, J Barbosa, I Bdikin, B Almeida, AG Rolo, ED Gomes, M Belsley, AL Kholkin, D Isakov, "Ferroelectric characterization of aligned barium titanate nanofibres", J. Phys. D-Appl. Phys., 46, 105304 (2013)

[5] D. Isakov, E.D. Gomes, B. Almeida, A.L. Kholkin, P. Zelenovskiy, M. Neradovskiy, V.Y. Shur, "Energy harvesting from nanofibers of hybrid organic ferroelectric dabcoHReO(4)", Appl. Phys. Lett., 104, 032907 (2014)