SCIENCESPRINGDAY

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Materials Science Department

Thermoelectric devices

CENIMAT/I3N and **DCM-FCT/UNL:**
- *Microelectronic and Optoelectronic Materials Group*

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INSTITUTE FOR NANOSTRUCTURES, NANOMODELLING AND NANOFABRICATION
RESEARCH, INNOVATION AND ENGINEERING APPLICATIONS

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2011 Post Doc at FCT
2011 PhD in Physics Engineering, thesis: "Lab on Chip microsystem for flow cytometric analysis, separation and counting of cells and particles"
2006 Graduated in Physics Engineering

Objectives

The concept of this research area is to solve crucial cooling and energy-management issues, for example in transport and energy-efficient applications, using thin film thermoelectric (TFTE) modules. TFTE modules are gaining research interest due to high rate between energy efficiency and consumption material. Besides that, TFTE makes possible its direct integration into integrated electronic circuits, optimizing its efficiency and packaging. This work involves the optimization of different thermoelectric metal oxide materials in order to reach high efficiency levels, as well as modules optimization (number of pairs, dimension, etc) according to the applications.

Methodology

- *Development of PN metal oxide materials with enhanced thermoelectric properties:*
  - Deposition by thermal evaporation and sputtering;
  - Material characterization (morphological, structural, optical, electrical);
  - Thermoelectric characterization (Seebeck coefficient, thermal resistance, figure of merit ZT).
- *Development of TE modules for cooling and energy generation:*
  - *Geometry optimization;*
  - *Functional characterization (net cooling, time response, efficiency, CoP).*
- *Demonstrator assembly*

Expected Results

The output of this research is expected to be VxMyOz and ZnxMyOz TE materials with ZT>0.1 and thicknesses below 100nm.

We expect to demonstrate the application of such TE materials in thin electronic devices like OLEDs, smart windows, flexible substrates and other electronic applications requiring low power consumption, like wrist watches, pacemakers, remote wireless sensors, etc.

Up to this moment, ZT~10^{-2} has already been reached and for the low thicknesses involved these are state of art results.

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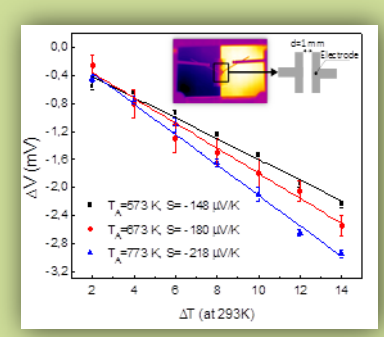

Figure 1

Example of a Seebeck coefficient measurement (slope of the output voltage versus temperature gradient).

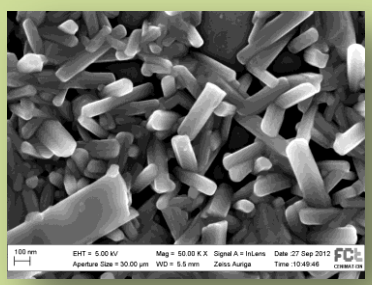

Figure 2

SEM image of $V_xAg_yO_z$ thin fim with TE properties.

Figure 3

Photograph of a TFTE element deposited on a flexible substrate.