Partnership

Principal Contractor

LNEG
Laboratório Nacional de Energia e Geologia, I. P.

Participating Institution

IST-ID
Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento

C²TN

NOVA id FCT
Associação para a Inovação e Desenvolvimento da FCT

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INSTITUTO DE NANOESTRUTURAS, NANOMODELAÇÃO E NANOFABRICAÇÃO

Collaborator Institution

Direcção Geral de Energia e Geologia

Research Area

Materials for Energy
Solar Energy

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Project Duration

01-10-2018 to 30-09-2021

Local Resources for Multifunctional Tetrahedrite-based Energy-Harvesting Applications

LocalEnergy

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FCT Fundação para a Ciência e a Tecnologia

REPÚBLICA PORTUGUESA

Motivation

Renewable energy sources play an important role in the energy transition and, consequently, in the energy mix of the future. This energy transition requires more progress in all aspects related with renewable technologies, including the research and innovation of new and improved materials, e.g., materials for harvesting energy from renewable sources or for converting wasted thermal energy into electricity with small local devices.

As a contribution to this worldwide effort, the research activities of LocalEnergy project are focused on the use of both natural and synthetic tetrahedrites for thermoelectric applications and of synthetic tetrahedrites-based materials as new solar absorbers for photovoltaic applications. This strategy is relevant and represents a great opportunity:

- By promoting and exploiting two important endogenous resources, solar energy and mineral. Portugal is one of the European nations with the highest level of solar energy irradiation and tetrahedrite is a local mineral resource, present in the Iberian Pyrite Belt (Fig. 1). The use of this two endogenous resources in innovative energy-harvesting applications is expected to impact positively, socially and economically, the solar (concentrated solar and photovoltaic) and mineral industries.

- By promoting the use tetrahedrite, a cooper antimony sulfosalt mineral consisting of earth-abundant and relatively non-toxic elements. The current thermoelectric materials and chalcogenide thin-film solar cells are based on rare or toxic elements.

Objectives

The transition to a decarbonized energy supply implies continuous innovation in materials and in low-carbon energy technologies. LocalEnergy is in line with this strategy by addressing the development and exploitation of environmental-friendly and scalable low-cost technologies related to energy conversion. The goal and research focus will be on the use of tetrahedrites, a class of copper antimony sulfosalt minerals ($Cu_{12-x}M_xSb_4S_{13}$, $x \leq 2$ and M = Fe, Zn, Ni, Mn), i.e., consisting of earth-abundant and relatively non-toxic elements, as materials for thermoelectricity production (Fig. 2) and as absorbers for thin film solar cells (TFSC) applications (Fig. 3).

LocalEnergy includes industry-oriented scientific activities with the following characteristics:

Novelty: Use of natural tetrahedrites, obtained from Iberian Pyrite Belt, for producing thermoelectric materials.
Use of powder technology to process synthetic tetrahedrites for the absorber layer of TFSC, suitable for large scale manufacture at low cost.

Long-term vision: Opportunity for developing sustainable energy systems based on the maximization and exploitation of Portuguese natural resources, namely, solar energy and mineral resources. Use of small local solar concentration facilities for direct production of electricity.

Excellent Science: Research in multiple scientific domains with multiple application levels comprising a multidisciplinary research team involving researchers and institutions with proven record of achievements in the field of materials science, geology and renewable energy.

Integration and training of young researchers: The amount allocated to this item corresponds to the largest budget share.

Dissemination: All the partners are firmly determined to promote technological development and to generate technology transfer and share and disseminate knowledge.

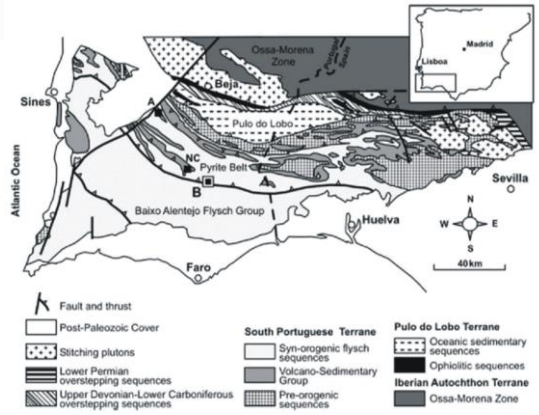

Fig. 1 - Geological setting of the Iberian Pyrite Belt (IPB).
A – Aljustrel; NC – Neves Corvo; B – Barrigão.
[Fiona K.M. Reisera, Diogo R.N. Rosa, Álvaro M.M. Pinto, João R.S. Carvalho, João X. Matos, Fernanda M.G. Guimarães, Luís C. Alves, Daniel P.S. de Oliveira, International Geology Review 53 (2011) 1212-1238]

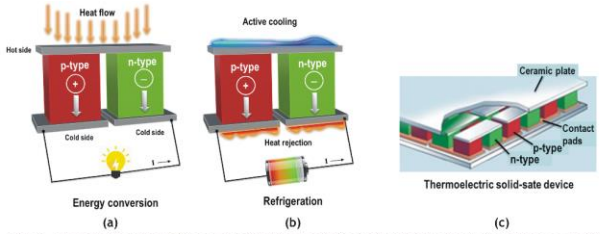

Fig. 2 - Schematic illustrations of a thermoelectric (TE) junction for (a) energy conversion (Seebeck effect), and (b) active refrigeration (Peltier effect). (c) Thermoelectric solid-state device. [Xiao Zhang, Li-Dong Zhao, Journal of Materiomics 1 (2015) 92-105]

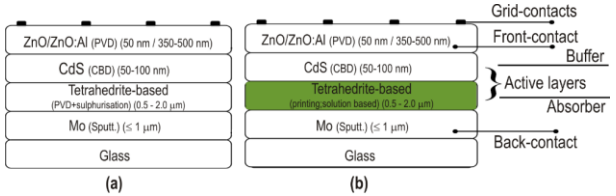

Fig. 3 - Schematic illustration of the typical tetrahedrite-based thin-film PV devices to be manufactured and evaluated.