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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Department of Materials Science

Development of Nanomorphous Silicon Solar Cells in Ceramic Substrates with Biomedical Application

Electronic and Optoelectronic Materials

MIT Portugal

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2009 – Present, PhD in Bio-Engineering and Nanotechnologies, MIT-Portugal Program and FCT - UNL
2008 – 2009, Advanced Studies in Bio-Engineering Systems, MIT-Portugal Program
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Objectives

This PhD thesis aims at the development and fabrication of high efficiency thin film silicon solar cells deposited on ceramic substrates, with a specific architectural design. The Biomedical Engineering application of these novel and innovative integrated photovoltaic ceramics will also be studied, namely for the design of a self-sufficient, by renewable energy, Field Hospital.

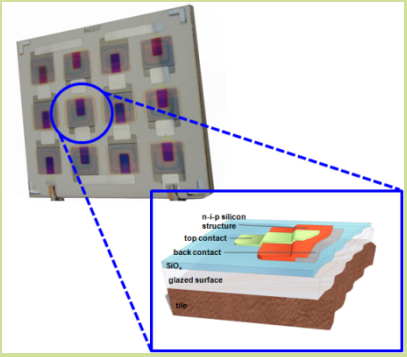

Fig.1 Prototype and Schematic of the deposited single junction Solar Cell.

Methodology

- The solar cells (SCs) are deposited by RF-PECVD on 10 x 10 cm tiles. Each tile possess 12 individual cells with an active area of 0.24cm², that can be connected in series to form a mini panel prototype. The top contact is a Transparent Conductive Oxide (TCO), deposited by RF sputtering (Fig 1).
- Individual layers are characterized in terms of morphological, optical and electric properties, by techniques such as dark conductivity, spectroscopic ellipsometry, SEM, XRD, XPS, AFM, FTIR and Raman measurements.
- The SCs are characterized by measuring its J-V characteristics in dark and calibrated illuminated conditions, and by external quantum efficiency (EQE) measured in a dedicated spectral response system.

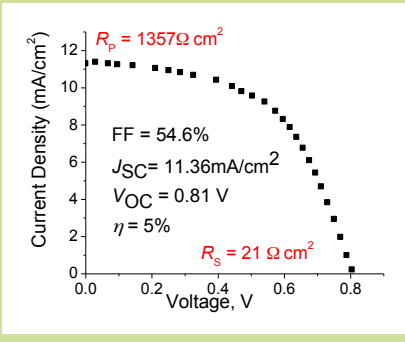

Fig.2 I-V Curve of the single junction Solar Cell deposited on tile.

Expected Results

- Using ceramic tiles as substrate, to obtain nanostructured "tandem" SCs $(n\text{-}i\text{-}p)_1$-$(n\text{-}i\text{-}p)_2$ SCs and overcome the 10% efficiency barrier.
  - ✓Preliminary results of SCs deposited directly on ceramic substrates (tiles) have achieved initial active-area efficiencies around 5% (single junction configuration) (Fig. 2). Mini-Modules containing 12 solar cells connected in series achieved initial open circuit voltage of 8.7V and 3% efficiency (Fig. 3).
- To develop a Decision Support Model to help the decision makers designing an appropriate Field Hospital and also determining the energy requirements and logistics of a self-sufficient by renewable energy FH, with the objective of reducing costs related to power consumption and to provide the community with a self-sufficient source of energy for the future.

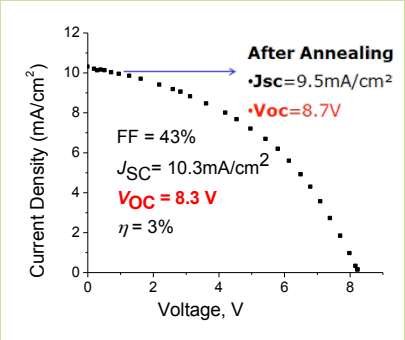

Fig.3 I-V Curve of the Solar Cell module.

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