Plasmonic rear architecture as an efficient light management strategy for ultrathin solar cells

A.J.N.Oliveira, PhD Candidate**, INL,** antonio.oliveira@inl.int

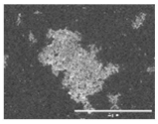
D. Ramos, R. Alexandre, E. Ribeiro, T. S. Lopes, A. Violas, J. P. Teixeira, P. A. Fernandes, P. M. P. Salomé, INL.

Nanotechnologies

Introduction

The $Cu(In,Ga)Se_2$ solar cells market expansion requires a reduction in the production costs and a performance increase. An ultrathin approach, satisfies the low-cost requirement. However, a thinner absorber leads to incomplete light absorption. Light scattering schemes are needed to compensate this optical loss.

Previous Work **- Micro-scale Texturing**

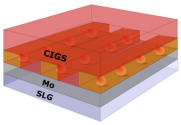


Short circuit current density(J_{SC})

Open circuit voltage(V_{OC})
Efficiency(η)

A. J. N. Oliveira, *et al.*, Sol. RRL,4, **2020**, 2000310

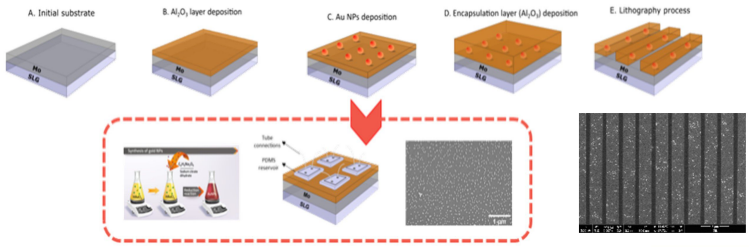
This work **- Plasmonic Substrate**



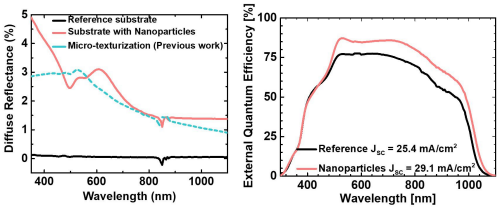
Individualized nanoparticles to promote an optical enhancement without electrical degradation

Plasmonic substrate development

The plasmonic rear architecture is developed through a process that combines microfluidics and an industry-compatible nanoimprint lithography.

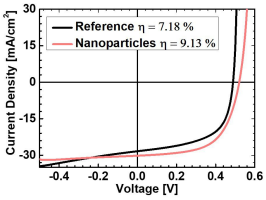


Optical Performance



Light Scattering from the Plasmonic rear substrate leads to an optical path length enhancement in the absorber, with an **15 % (rel) J_{SC} increase.**

J-V Measurements

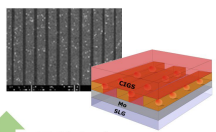


The developed rear architecture allowed for an improved optoelectronic performance with a **27 % (rel) η enhancement**.

Conclusions

Individualized Gold Nanoparticles with diameter of 100 nm enabled an improved J_{SC} without electrical degradation in an ultrathin cell.

Optical performance may still be improved by optimization of dielectric encapsulation layer and NPs surface coverage.



15 % J_{SC} increase

27 % η increase

FULBRIGHT Portugal
HORIZON 2020
FCT Fundação para a Ciência e a Tecnologia
COMPETE 2020
UTAustin Portugal
FCT Fundação para a Ciência e a Tecnologia
TEXAS
ciimar