



Tailored nanolaminates for solar cells applications

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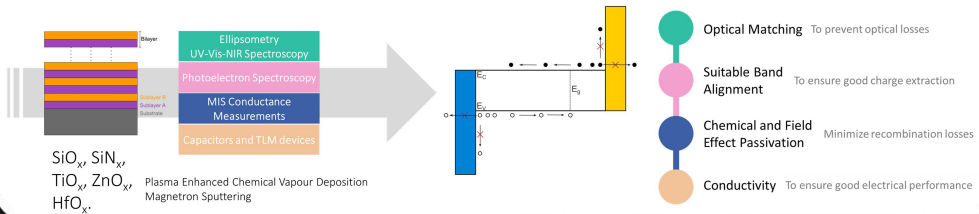
J.P. Teixeira, R. C. Vilão, A.J.N. Oliveira, K. Oliveira, M.A. Curado, M. Monteiro, T.S. Lopes, C. Matos, J. Lisboa, R.D. Pinto, P.A. Fernandes, P.M.P. Salomé

Introduction

¹IEEE J. Photovolt. 9, 1863 (2019) ². Phys. D: Appl. Phys. 55, 17300 (2022)

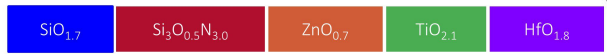
The photovoltaic technological portfolio needs to be upgraded. **Cu(In,Ga)Se₂ (CIGS)** has been deeply studied, allowing for light to power efficiency values up to 23%¹. Nonetheless, solar cell design has been kept mostly unchanged.

*"(...) This should be one goal of future CIGS device optimization strategies. In addition to the approaches discussed previously, collection can be further improved by using passivated selective contacts that are optimized for electron and hole collection. (...)"*²

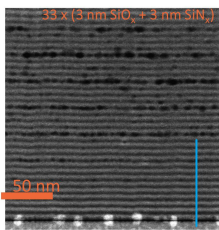


Results

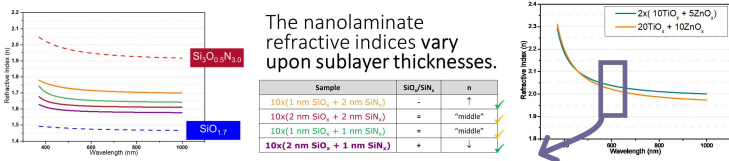
Elemental distribution by XPS



Structure by TEM



Optical Properties by Ellipsometry and UV-VIS-NIR Spectroscopy:

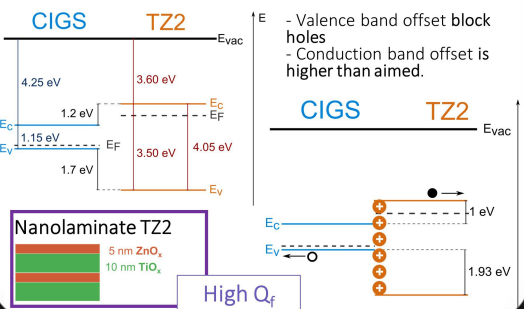


The nanolaminate refractive indices vary upon sublayer thicknesses.
For minimizing inner reflections, an electron selective contact for CIGS should have 2.0-2.5 refractive index, at 600 nm.

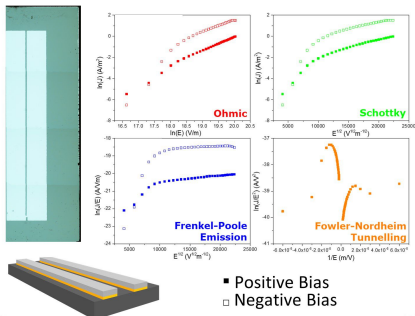
Parallel and separated layers.
HAADF linescan: bilayer of 5.2±0.2 nm

Selectivity by XPS
Nanolaminates with n-type conductivity

Selectivity and Passivation



Conductivity by Home-made devices



Summary

- Optical Matching ✓
- Selectivity ✓
- Passivation ✓
- Conductivity ✗

The obtained results support the tailoring of several properties via different nanolaminates' schemes.

A TiO_x-ZnO_x-based nanolaminate showed potential for an electron selective layer application.

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