Oxide nanostructures by ALD and hydrothermal methods for photovoltaic applications

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INTRODUCTION

We developed innovative oxide nanostructures for application potential in the photovoltaic (PV) industry, in particular as three-dimensional transparent electrodes, simplified Si cells and antireflective layers for PV cells of different generations. In addition, a novel technology of CuO absorbing layer, an alternative to CdTe layers, is developed. We use two growth methods of oxides - atomic layer deposition (ALD) method and a novel modification of a hydrothermal method.

ALD

ALTERNATIVE SUPPLY OF COMPONENTS

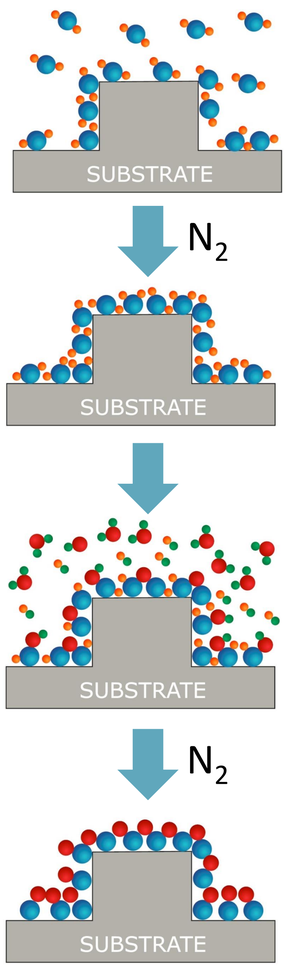
- No reaction in a gas phase
- Possibility of use of reactive precursors
- Low growth temperature is possible

HIGH UNIFORMITY

- Uniform covering of very complicated structures

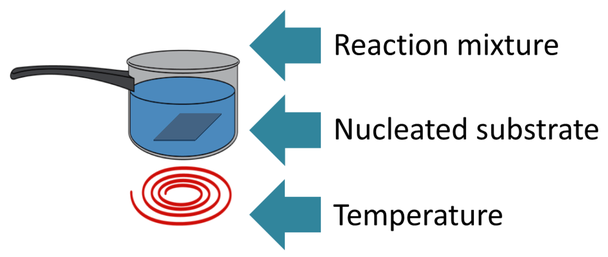
SELF-LIMMITING PROCESS

- Growth rate is NOT dependent on flux homogeneity
- Maximal growth rate: 1 monolayer per cycle



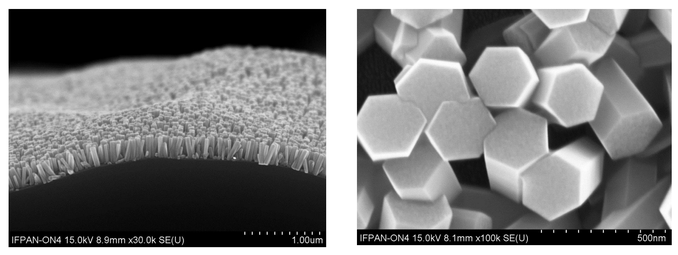
HYDROTHERMAL METHOD

- Growth at low temperature (below 100°C)
- No need for sophisticated and expensive equipment
- Very high growth rate
- Growth possible on almost any type of substrate
- Simple control of nanostructures sizes



GROWTH OF ZnO NRs

Reaction mixture = Zinc Acetate + Deionised water + pH regulator



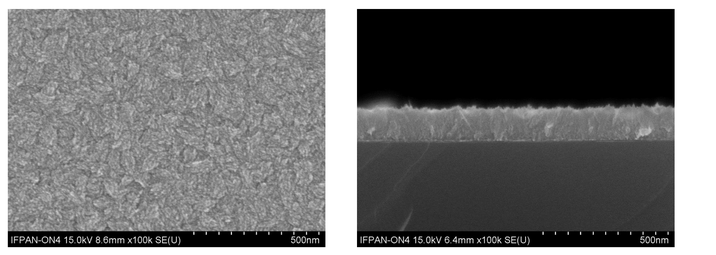
Growth time: 1-2 minutes

Total cost of NRs growth (15.6x15.6 cm^2): **0.04 EUR**

Patent no. PL226487

GROWTH OF CuO THIN FILMS

Reaction mixture = Zinc Acetate + Deionised water + pH regulator



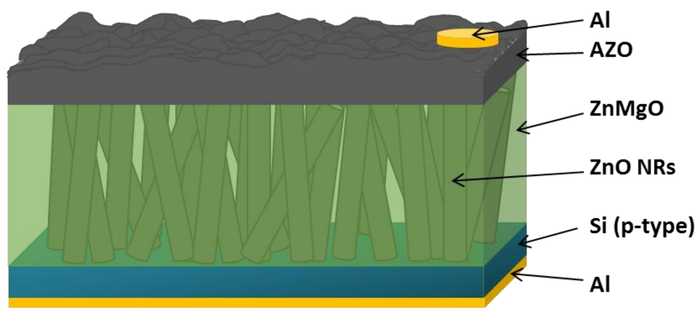
Growth time: 40 s – 6 minutes

Total cost of growth (15.6x15.6 cm^2): **0.06 EUR**

Patent application no. P.429066

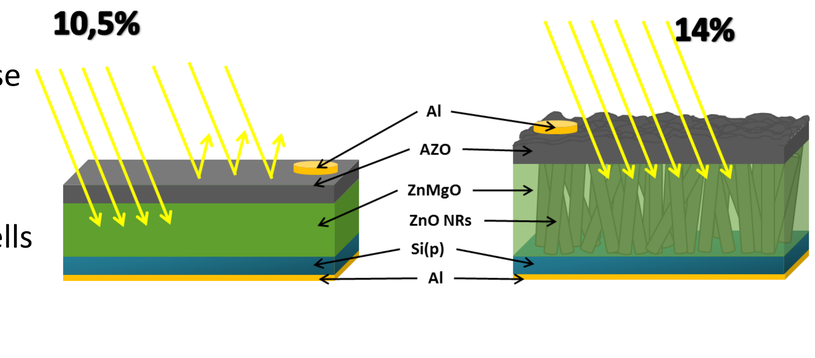
3D TRANSPARENT ELECTRODE

The developed electrode is a combination of ZnO nanorods grown by the hydrothermal method and doped ZnO layers obtained by the ALD method.



Patent no. PL227817

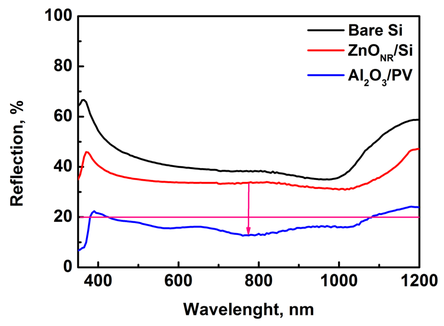
- High transparency
- Expanded surface without the use of toxic processes
- Improved light trapping
- Increasing the efficiency of PV cells
- Cost reduction



ANTIREFLECTIVE LAYERS

Antireflective layers consist of nano-layers selected in the right order, type and thickness based on their light reflection coefficients.

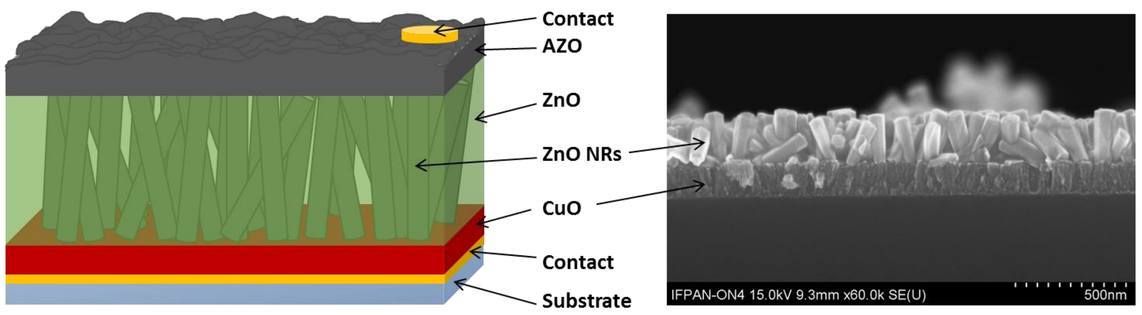
- Reduction of reflected light
- Improving the efficiency of PV cells
- Protective barrier
- Possibility of application in any type of PV cell



Anti-reflective layers are created using the ALD method. It is possible to implement the solution on a large scale due to the fact that there are industrial versions of ALD reactors allowing large substrates.

CuO THIN FILMS FOR PHOTOVOLTAICS

CuO layers have been a very intensive area of research for many scientific institutions, as a potentially active layers absorbing light in solar cells, in particular as an alternative to CdTe or Si. **Until now, technology has been the main barrier in the application of CuO films.**



WHAT'S NEXT?

We have developed technologies that can be used successfully in photovoltaics, as well as in other fields (eg. In sensor devices). Currently, we are looking for partners for R+D projects to continue our research and work on our inventions. We are ready to adapt our technologies to specific production requirements.

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