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W/W-SICH/TAO_XN_Y SOLAR SELECTIVE ABSORBER COATINGS FOR CONCENTRATED SOLAR POWER

DEPO - Plasma - deposited coatings for optical, electronical and other functionalitie

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Abstract content

The improvement of solar technologies (PV, Concentrated Solar Power, PV/CSP hybridization) requires the design and elaboration of new materials solutions able to limit optical and thermal losses, but also to resist to damaging operating conditions, by using stable thin films with controlled spectrally selective properties.

Solar selective absorber coatings to improve the performance of CSP solar receivers in air, with a high transfer potential to industry, were developed in the ANR NANOPLAST project (nanoplast-project.cnrs.fr). These coatings are composed of: (i) a W/W-SiCH selective absorber deposited by reactive magnetron sputtering assisted by microwave sources involving a tungsten target in an argon/TetraMethylsilane (TMS) plasma and; (ii) a TaO_xN_y antireflective layer deposited by sputtering a tantalum target in an $Ar/O_2/N_2$ plasma.

The multilayered coatings and their constitutive monolayers were studied by various characterisation techniques (SEM, IBA, XPS, XRD, PDF and EPR) in order to investigate their physicochemical properties, microstructure and chemical composition, as-deposited and after aging at 500°C in air. The solar performance was simulated and optimized by optical modelling, based on the measurement of their optical indices by confronting ellipsometric spectroscopy and UV-Vis-NIR spectroscopy, and measured by spectrophotometry in the solar range. A deeper study of their thermal stability in air will be carried out using a thermal cycling ageing process to get closer to the real operating conditions of concentrated solar power receivers.

In the framework of the Selhysol project (supported by French Occitanie Region and University of Perpignan), similar absorber coatings are reoptimized by optical simulation and used for hybrid PV/CSP systems based on selective PV mirrors. The latter allow the absorption of the effective part of the solar spectrum by underlying PV cells while reflecting the remainder of the solar spectrum towards a CSP thermal absorber.