W/WSiCH/TaO_xN_y solar selective absorber coatings for concentrated solar

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The improvement of solar technologies (PV, Concentrated Solar Thermal, PV/CST hybridization) requires the design and synthesis 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 CST solar receivers in air, with a high transfer potential to industry, were developed in the ANR NANOPLAST project [1]. These coatings are composed of: (i) a W/WSiCH selective absorber deposited by reactive magnetron sputtering assisted by microwave sources, involving a tungsten target in an argon/TetraMethylsilane (TMS) plasma [2], 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 [3], 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 thermal receivers.

References :

[1] The NanoPlaST project [Internet]. ANR NanoPlaST. 2023 [cited 2024 Apr 17]. Available from: https://nanoplast-project.cnrs.fr/.

[2] Diop A, Ngoue D, Mahammou A, et al. Comprehensive study of WSiC:H coatings synthesized by microwave-assisted RF reactive sputtering. Surface and Coatings Technology. 2023;459:129408.

[3] solpoc: Solar Performances Optimization Code (SolPOC) is an Academic research code, used for solar energy. SolPOC can solve and optimize a stack of thin layers for designed solar mirror, antireflective coating, thermal absorber etc. [Internet]. [cited 2024 Apr 18]. Available from: https://github.com/SolPOCandCo/SolPOC.

Mots-clés : Plasma, Thin films, concentrated solar thermal