#PLATH00056

OPTICAL PERFORMANCE OF HIGH TEMPERATURE AIR-STABLE SOLAR ABSORBER COATINGS BASED ON W/SICH PLASMA MULTILAYERS

ENER / Renewable energies

A. Diop [1], D. NGOUE [1, 2], A. CARLING-PLAZA [1], A. BOUSQUET [3, 4], S. QUOIZOLA [1, 2], T. SAUVAGE [5], A. GOULLET [6], A. SOUM-GLAUDE [1], É. TOMASELLA [3, 4], L. THOMAS [1, 2].

[1]PROMES-CNRS (Laboratory of PROcesses, Materials, Solar Energy) - PERPIGNAN/FONT-ROMEU-ODEILLO-VIA (France), [2]UNIVERSITE DE PERPIGNAN - Perpignan (France), [3]ICCF (Institut de Chimie de Clermont-Ferrand) - CLERMONT-FERRAND (France), [4]UNIVERSITE CLERMONT AUVERGNE - Aubière (France), [5]CEMHTI (Conditions Extrêmes et Matériaux) - ORLÉANS (France), [6]IMN (Institut des Matériaux Jean Rouxel) - NANTES (France)

Abstract content

CSP technologies (Concentrated Solar Power) are growing strongly in the global energy mix. Improving their performance, an essential solution to intermittent solar radiation, requires the development of highly absorbent coatings aimed at increasing the temperature of heat transfer fluids and lowering the cost of receivers whose surface converts the concentrated solar flux into heat. Innovative spectrally selective thermo-optical structures maximise solar absorption while minimising radiative heat loss (low reflectance in the solar region of the spectrum (0.25 - 2.5 µm) and high reflectance in the infrared (>2.5 µm)), and must withstand temperatures (up to 800°C) in air while maintaining their optical properties.

This paper presents the metal-dielectric multilayer stacks based on W and SiCH materials developed in various projects: ANR ASTORIX (2014-2019), French Region Occitanie PLASMECO (2018-2021), ANR NANOPLAST (2019-2023). They are deposited using low pressure plasma techniques: magnetron sputtering PVD for W and PECVD microwave for SiCH. Solar absorptance, thermal emittance and heliothermal efficiency, corresponding to the materials optical performance, were studied on a reference stack and stacks annealed for 500°C in filtered air (without H2O and CO2) for 12h, 24h, 48h and 96h. The results showed that, on one hand, the samples were not degraded after annealing and, on the other hand, after 12h, there was an increase in solar absorption up to 92% and a reduction in thermal emittance of 14 points, leading to an increase in heliothermal efficiency of 14 points. For longer aging, optical properties remain stable. SEM, EDS, RBS and FTIR characterisations show thickening and oxygen incorporation into the material due to aging. This may reflect the formation of a protective SiO layer on the surface of the coatings during the early stages of aging which protects the material from further oxidation.