ACCELERATED AGING TESTS FOR SPECTRALLY SOLAR SELECTIVE ABSORBERS BASED ON NICKEL OXIDE

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Synopsis

Solar selective coatings consisting on alumina/copper oxide matrix infiltrated with nickel oxides nanoparticles were obtained by spray pyrolysis technique. The deposition parameters were optimized to achieve high solar absorptance (α_s>0.92) and low emittance (ε_T<0.7). Condensation, high temperature and aggressive pollutants tests are recommended for solar absorber coatings. However, the condensation test is the most important to perform on this type of solar absorbers because previous experience shows that alumina/copper can be sensitive to moisture. Stability in saline solution/water with different pH was also tested to determine the functioning domain. The samples optical characteristics before and after the accelerated aging testing were investigated. The influence of the antireflection layer – TiO_2 on the solar absorbers stability and durability was investigated.

Abstract

Spectrally solar selective coatings that absorb and convert solar radiation into heat are required to improve the solar collectors' efficiency, thus the conversion of solar radiation into thermal energy.

High performing selective surfaces already exists already on the market but they present several disadvantages like cost, complicated production techniques, moisture resistance and long-term durability. In order to make solar thermal collectors more accepted and widespread, the price per unit has to decrease. This can be achieved by decreasing the cost of the solar coatings, the most costly component of a thermal solar collector.

Low cost and high durability absorber coatings should be obtained using thin film (low amount of chemical involved), using simple and up-scalable techniques, able to be applied on large surfaces, with various geometries. The deposition method that fulfills these conditions is Spray Pyrolysis Deposition (SPD) technique.

The paper presents the accelerated aging tests of two spectrally selective coatings: $Al/Al_2O_3/NiO$ and $Cu/CuO/NiO$. Standard condensation tests and stability in water solutions with different pH (pH = 3, 5, 7, 10, 12 for 12, 24 and 48 hours) and in saline (NaCl 3.5 %) solutions and were performed. The solar absorptance, α_s and thermal emittance, ε_T were calculated before and after testing and they were correlated with film's surface morphology and chemical composition.

The selectivity variation ($S=\alpha_s/\varepsilon_T$) obtained in the case of water test stability are presented in the figure below. The TiO_2 deposition, as anti-reflective and protective layer, improves significantly the solar coatings stability.

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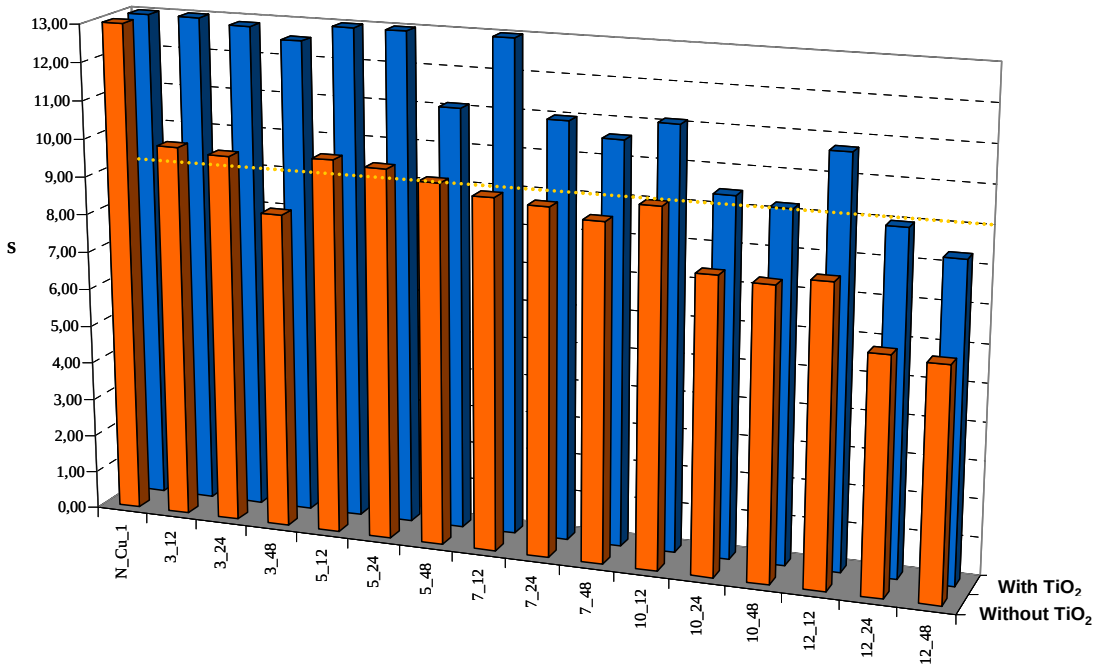

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