Efficiency of a Solar Selective Coating at Working Temperature: Errors Due to Room Temperature Emissivity Extrapolation

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Solar thermal collectors (STC) are especially relevant in solar thermal devices for producing heat from the sun (T < 150ºC), or producing electricity in concentrated solar power (CSP) plants (250 < T < 800 ºC). A critical component of solar thermal collectors is the surface that facilitates the conversion of solar radiation into useful heat. These solar absorbing surfaces (SAS) require very high solar absorptivity at visible and near-infrared wavelengths and low emissivity in the mid-infrared spectral region. An effective coating requires an absorptivity over 95% and an emissivity below 5% at working temperature. Previous studies of the SAS emissivity have been done by extrapolating reflectivity values from room temperature to the working one or by measuring the total emissivity with an emissometer below 100 ºC. These methods do not take into account the emissivity temperature dependence and therefore they might lead to significant errors depending on the actual emissivity temperature behavior. Small differences in emissivity values will affect the coating efficiency and have an important economic impact on the thermosolar electricity production. In this work, spectral emissivity of CERMET-based multilayer stacks at working temperature (600 ºC) has been studied. Normal spectral emissivity was measured between 2 and 20 microns between 250 and 600 ºC and afterwards the spectral curves were integrated in order to obtain the total emissivity values. In conclusion, despite small emissivity temperature dependence, notable differences between the values obtained directly at working temperature and those extrapolated are found. Therefore, in order to ensure a proper characterization, it is imperative to measure the emissivity at working temperature.

References

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