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Vacuum and in-air thermal stability studies of SnO2-based TCO for concentrated solar power applications

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In concentrated solar power plants the receiver tubes are one of the key components for increasing the energy efficiency. Absorber materials of those tubes have to exhibit high-temperature and air stability, high optical absorption in the solar region and low thermal emittance. In state of the art central tower plants black paints (i.e. Pyromark 2500) are used as absorber material but the high emissivity of those paints leads to high radiative energy losses. Moreover, these paints undergo a temporal degradation and performance loss during the lifetime of the plant.
Here, an alternative concept for high-temperature stable solar-selective coatings is presented. It consists of a transparent conductive oxide (TCO) deposited as solar-selective transmitter on a black body absorber. For this purpose, SnO_2:Ta thin films were reactively sputtered on fused quartz substrates. Their vacuum and in-air stability up to 800°C were studied by in situ Rutherford backscattering spectrometry (RBS), Raman spectroscopy and spectroscopic ellipsometry (SE). The correlation between structural, optical and electric transport properties was analyzed by RBS, SE, UV-VIS spectrometry, and Hall Effect measurements. Solar selective properties are demonstrated as proof of concept for the TCO deposited on a silicon substrate.
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