OR1302

High temperature stable TCOs as selective transmitter for solar thermal applications

Frank Lungwitz[1], Erik Schumann[1], Elena Guillen[2], Ramon Escobar[2], Matthias Krause[1], Sibylle Gemming[1]

[1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany [2]Abengoa Research, Sevilla, Spain

f.lungwitz@hzdr.de

Materials used in the receiver tubes of a solar thermal power plant must exhibit several properties, e.g. high temperature stability, high absorption in the solar region and low thermal emittance. Nowadays, temperatures of up to 450°C and up to 550°C are reached using parabolic trough arrays and solar tower absorbers, respectively, whereas temperatures up to 800°C or higher could be reached if the receiver materials were stable enough. Previous R&D approaches for high temperature solar receiver materials include multilayer coatings deposited by PVD or sol-gel techniques. Here, a new concept for solar-selective coating is presented. A transparent conductive oxide (TCO) is deposited as a solar selective transmitter on a black body absorber to implement both, high absorption (from the black body) in the ultraviolet, visible and near infrared spectral range (300 nm – 2500 nm) as well as high reflectivity (from the TCO) in the infrared (> 2500 nm) in a relative simple material design.
Therefore SnO_2:Ta and TiO_2:Ta thin films are reactively magnetron co-sputtered from tantalum doped and undoped metal targets at high temperatures (400°C - 700°C). By changing dopant concentration, oxygen flux, process pressure and deposition temperature the optical properties of these films can be tailored to meet the requirements of a solar selective transmitter coating. It is also shown that the electrical properties of the TCO, namely charge carrier concentration and mobility, determine the optical behavior. The correlation between structural, optical, and electrical properties is analyzed by Raman Spectroscopy and Spectroscopic Ellipsometry (SE) both at room- and especially (in situ) at high- temperatures simulating the conditions where the functional coating is supposed to operate. Additionally, Rutherford Backscattering Spectroscopy (RBS), X-ray Diffraction (XRD), UV-VIS spectrometry, and Hall Effect measurements are performed.
Financial support by the EU, grant No. 645725, project FRIENDS[2], and the HGF via the W3 program (S.G.) is gratefully acknowledged.

Keywords
solar thermal
transparent conductive oxide