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Doping of VO2 selective coatings for solar thermal collectors

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The reversible semiconductor-to-metal transition in VO_2 at 68 °C makes this material suitable for various technological applications. Apart from studies for use as coating for smart windows or sensing devices, doped VO_2 layers were investigated as functional (thermochromic) coating material for solar thermal collectors [1] [2].
For solar absorbers, in order to ensure optimal collector efficiency, the absorption of solar irradiation has to be maximised while the thermal emissivity has to be minimised in the visible and mid-infrared wavenumber region. Today state of the art commercially available absorbers with non-thermochromic and selective coating materials fulfil these requirements. However, avoiding extensively high stagnation temperatures in modern solar thermal collectors results in a raising interest in absorber coatings that may change their optical behaviour with temperature.
We co-sputter various doping metals [Me] and vanadium in a magnetron system constructed by DREEBIT GmbH to identify doping effects on VO_2 with respect to the optical behaviour and the temperature of the semiconductor-to-metal transition. We perform a subsequent annealing in air to form crystalline phases in this $V_{1-x}[Me]_xO_2$ / SiO_2 - layers. We vary the content of the doping metal and the temperature-time-profile of the subsequent annealing process. Samples are analysed by XRD-measurements for phase identification, stoichiometry is determined by EDX-measurements and morphology by SEM-pictures. As optical properties are essential for such films we perform optical analysis using reflection, transmission and ellipsometry spectra in die visible and mid□infrared wavenumber region.
We show recent results on morphology, optical behaviour and changes in transition temperature of these layers.

[1] A. Paone et al., Sol. Energy, vol. 110, pp. 151–159, Dec. 2014.
[2] D. Mercs et al., Energy Procedia, vol. 91, pp. 84–93, Jun. 2016.

Keywords
vanadium dioxide
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