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Wetting properties of ZnO-films on glass deposited by Pulsed-DC Magnetron Sputtering

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Wetting properties of glass surfaces play an important role for the soiling behavior and the engineering of anti-soiling functions. Soiling is of particular interest in photovoltaics when solar modules are to be utilized in dusty urban or arid environments.
In this work macroscopic (water contact angle, optical transmission) and correlated microscopic (surface structure, surface chemistry) properties are studied as a function of layer deposition parameters. Zn oxide films are deposited on glass using Pulsed-DC Magnetron Sputtering of an intrinsic and an aluminum doped zinc oxide target. The process parameters pressure, sample temperature, plasma frequency, plasma power and deposition time are varied. Furthermore, heating experiments under atmospheric conditions with temperatures up to 600°C are performed.
The film thickness, optical transmission and surface contact angle of water are determined in dependence of the process parameters. To identify the origin of changes in water contact angle, surface morphology and surface chemistry are investigated by atomic force microscopy (AFM), electron microscopy (SEM) and X-ray Photoelectron Spectroscopy (XPS). In addition to the variation of process parameters, influences of sample storage are analyzed.
By changing the deposition process, variations in the contact angle of more than 70° are detected. Furthermore, the film thickness changes significantly by varying the process parameters. Therefore, shifts in peak positions of optical transmission can be seen, which is important in terms of optimization for photovoltaic application. The anti-soiling functionality of the deposited Zn oxide films will be tested in a laboratory soiling test setup.

Keywords
ZnO
contact angle
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film characterization
microstructure