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Thermal and compositional defects in dip-coated iron oxide (α-Fe₂O₃) thin film photoanodes: Effects on film properties

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Abstract content
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Hematite (α-Fe₂O₃) is an attractive semiconductor material for solar assisted electrolysis of water due to its narrow band (˜ 2.1 eV), low cost and non-toxicity. α-Fe₂O₃ thin films photoanodes were synthesized by dip coating and their properties investigated with FESEM, XRD and photocurrent density spectroscopy. Strong dependence of structural and photoelectrochemical properties on film compositions and temperature was observed. The crystallites size was observed to increase with increasing Ti doping concentration. By fixing the doping concentration at 1 mol %, the photocurrent density at water splitting potential (1.23 V vs RHE) increased from 0.006 mA/cm⁻² at 450 ℃ to 0.386 and 0.766 mA/cm⁻²at 500 and 550 ℃ respectively then decreased to 0.249 mA/cm⁻² at 600 ℃. Subsequent annealing temperatures introduced textural and structural defects with modifications in the film properties. The films cracked with cracks averaged 50 nm. Cracks may act as collection centres for impurities diffusing out of the lattice hence act as scattering sources for photons and carriers with consequent decrease in photoresponse of the films.

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