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Hybrid Reactive High Power Impulse Magnetron Sputtering System used for the Deposition of Semiconductor Thin Films for Photoelectrochemical Applications.

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A hybrid high power impulse magnetron sputtering combined with an electron cyclotron wave resonance plasma source (r-HiPIMS+ECWR) was used for the deposition of p-type $CuFeO_2$/CuO and n type Fe_2O_3:Sn thin films. These p-type and n-type semiconducting oxides work as photocathode and photoanode for solar water splitting PEC cells, respectively. Two magnetron sources were used for the reactive co-sputtering. An additional plasma source based on special modification of inductively coupled plasma ECWR, was used for further enhancement of plasma density. A RF planar probe was used to investigate the time evolution of ion flux density during the pulsing cycle. A special modification of this planar RF probe made it possible to investigate the time evolution of both T_e and of the ion concentration n_i. Generally, it was found that the obtained ion flux density and the T_e were systematically higher in case of r-HiPIMS+ECWR plasma compared to pure r-HiPIMS during the active part of the discharge pulse. $CuFeO_2$/CuO thin films were deposited at different conditions and various crystal structures were achieved after annealing in air and in vacuum. Photocurrents in cathodic region for different crystal structures were observed by chopped light linear voltammetry and chronoamperometry. Fe_2O_3 films doped with Sn were investigated from the point of view of maximum achieved photocurrents in anodic region under illumination in dependence of crystal structure and Sn dopant concentration.

Keywords
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