# Nanostructured iron oxide thin films as photoanodes for water splitting

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A great effort is currently devoted to the development of technologies and materials suitable for the conversion of sunlight into chemical energy by photoelectrochemical water splitting. In this process, hydrogen is produced, using sunlight and water, by means of a photoactive material that is able to simultaneously harvest solar light and perform water oxidation (photoanode) or reduction (photocathode) reaction. Iron(III) oxide in crystalline structure of hematite ($\alpha$-$Fe_2O_3$) is considered a promising candidate as photoanode, thanks to its gap of 1.9-2.2 eV, allowing visible light absorption below 650 nm, large earth-abundance, low cost, nontoxicity, along with the stability in water and under illumination.

Our work focuses on the RF-sputtering deposition of iron oxides ($FeO_x$) thin films, from an iron target, in $Ar/O_2$ plasmas. Once deposited, films undergo thermal annealing in oxygen atmosphere. Film chemical composition and structure, as well as photoelectrochemical activity, were investigated as a function of the oxygen percent in the plasma feed mixture, and of the annealing temperature.

Results show that deposition in pure argon leads to nanostructured iron coatings with an oxide top layer, converted to hematite ($\alpha$-$Fe_2O_3$) upon thermal annealing. The addition of oxygen to the plasma feed mixture allows to grow directly hematite coatings. Photocurrents as high as 0.58 and 2.47 mA $cm^{-2}$ at 1.23 and 1.7 V vs $V_{RHE}$, respectively, are achieved upon thermal annealing.