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Electrochemical water splitting on non-noble metal oxide films grown by PECVD

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The most desirable method of hydrogen production, which represents a sustainable fuel of the future, is photoelectrochemical (PEC) splitting of water by visible light. A very important issue in the PEC hydrogen generation is the development of a high performance photoelectrode that exhibits high efficiency in the conversion of solar energy into chemical energy, resistance to corrosion in aqueous environments, and low processing costs. However, after four decades of intensive research, since the first report on water photo-splitting, no material has been found to simultaneously satisfy all the criteria required for widespread PEC application. No wonder that a quest for new materials for photoelectrodes is still ongoing. Recently, the PECVD technique is also heavily involved in this search. In this paper, we will present our research on plasma-deposited non-noble metal oxide films as potential electro- and photo-catalysts for the water splitting. The films, such as FeOx, CoOx, CuOx, were prepared on a carbon paper or a calcined kanthal substrate from appropriate metalorganic precursors in an RF (13.56 MHz) glow discharge and then they were tested as electrodes for the oxygen evolution reaction (OER). The electrochemical experiments were carried out in a three-electrode electrochemical cell adopted for photoconductivity measurements. In addition to the characteristics of the electrochemical properties of the films, their composition and nanostructure were examined by EDX, XPS, SEM and Raman spectroscopy. The obtained results seem to be promising and encourage further research on cold plasma produced metal oxide films as the electrochemical catalysts for processes related to the water splitting. The study was supported by the Polish National Science Center, on the bases of decision DEC□2012/07/B/ST8/03670.

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