Accuracy improvement of X-ray photoelectron spectroscopy performance for reliability of PtFe alloy nanohybrid data

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Recently, bimetallic PtFe nanoparticles were applied as the counter electrode for dye sensitized solar cell [Omelianovych et al., Electrochimica Acta 211 (2016) 842]. As the result, Pt0.75Fe0.25 alloy CE exhibited the highest electrochemical catalytic activity among CEs, resulting 8.94% efficiency which is higher than that of DSC employing Pt electrode. The optimization was conducted through XPS experimental data.
In this study, we present the great impact of the Ar+ sputtering prior to XPS-measurements on the chemical state of PtFe alloy. This research provides ways to obtain reliable data using XPS analysis for alloys system consist of nanosize particles. The pre-treatment (Ar+ cleaning) of the Pt0.75Fe0.25 resulted in partial reduction of Fe-oxides to a bulk metal state and lower oxidation state. Through investigation of the processing parameters of Ar+ plasma treatment in range of 1 to 3 keV as an ion beam energy and 1.5-0.5 μA as ion beam current, we found that pre-treatment under 1 keV – ion beam energy and with ion beam current of 0.5 μA was the best condition for the least changes in the alloy structure.