Atomic layer deposition of Palladium coated TiO 2 /Si nanopillars: a TOF-SIMS, AES and XPS characterization study.

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Nanocomposite based on Palladium (Pd) Coated TiO_2/Si nanopillars is an attractive candidate for photocatalytic applications because of its outstanding electrochemical and optical characteristics. In this research, Pd/TiO_2/Si nanopillars were synthesized by combination of metal-assisted chemical etching and atomic layer deposition, and then the surface was investigated by means of Electron microscopy, Time-of-Flight Secondary Ion Mass-Spectrometry (ToF-SIMS), Auger Electron Spectroscopy (AES) and X-Ray Photoelectron spectroscopy (XPS). The spatial distribution of different chemical components and contaminations on the surface of the produced nanocomposites was evaluated by ToF-SIMS mapping. Depth profiling by AES was carried out to determine the chemical composition and the conformality of Pd and TiO_2 layer over the Si pillars. The elemental composition and stoichiometry were determined by XPS analysis. The XPS valence band analysis was performed in order to investigate the modification of TiO_2/Si nanopillars electronic structure after Pd deposition. It was found that the Pd coating decreases the concentration of photoactive defects that reduce the photoelectrochemical efficiency of TiO_2. It was shown that the complementary use of these techniques allows not only to determine the chemical composition, but also to predict the photoelectrochemical properties of the produced nanocomposites.