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

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Nanocomposite based on Palladium (Pd) Coated TiO\textsubscript{2}/Si nanopillars is an attractive candidate for photocatalytic applications because of its outstanding electrochemical and optical characteristics. In this research, Pd/TiO\textsubscript{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\textsubscript{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\textsubscript{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\textsubscript{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.