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Long Term Performance of the TiO2 Photocatalytic Films Modified by Ag or Pt Nanoparticles

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It is possible to enhance the photocatalytic efficiency of the TiO_2 films by formation of an electron trap on the TiO_2 surface. Such trap can be created by depositing metal nanoparticles on the TiO_2 surface. This reduces the electron-hole recombination rate due to the Schottky barrier at the metal/TiO_2 interface.
This work is focused on the long term stability of the photocatalytic properties of TiO_2 films modified by silver and platinum nanoparticles separately. The deposition of TiO_2 films was carried out in the radio frequency (RF) low-pressure PECVD reactor. Surface of TiO_2 films was subsequently covered by various amount of platinum or silver nanoparticles that were deposited by means of PVD (magnetron sputtering). The amount of metal particles was evaluated by SEM and changes in chemical composition of the surface by XPS. The photocatalytic decomposition ability of the films was determined by measuring the decomposition rate of the organic dye Acid orange 7 (AO7) $C_{16}H_{11}N_2NaO_4S$. The photocatalytic activity was significantly enhanced by the nanoparticles deposition. Although the enhancement (up to 8 times higher activity immediately after nanoparticles deposition) did not sustained for extended time period, after 1 year it was still reasonably higher (approx. 3 times higher) compared to untreated TiO_2 films. The aged films with nanoparticle modification showed photocatalytic activity comparable to sedimented powder Degussa P25.

Keywords
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silver