Investigation of photocatalytic activity of titanium dioxide coating deposited on aluminium alloy substrate by plasma technique

Nowadays, there is an increased need for functionalized surfaces with self-cleaning and antibacterial properties. Titanium dioxide (TiO2) in the anatase crystalline structure is one of the most powerful photocatalytic materials available today, which can provide above functionalities. The photocatalytic process is initiated by UV-light in TiO2 which creates electron-hole pairs in the conduction band (CB) and valence band (VB) of TiO2, respectively. The electron/hole pairs generated have sufficient energy to cause reduction and oxidation on its surface providing the self-cleaning effect. Literature consists of large number of publications on titanium dioxide coating for self-cleaning applications, with glass as the main substrate. Only little work is available on TiO2 coating of metallic alloys used for engineering applications. Engineering materials, such as light-weight aluminium and steel have wide spread technological applications, where a combination of self-cleaning properties has a huge business potential. The results presented in this paper demonstrate superior photocatalytic properties of TiO2 coated aluminium compared to nano-scale TiO2 coating on glass substrate. The thickness of the coating strongly influences the photocatalytic properties. In general, the photocatalytic activity increased with thickness. Quantification of images scanned with Atomic Force Microscope (AFM) revealed that there is a linear relationship between the thickness of the coating and the average cell size of the crystals. Furthermore, it manifested that the surface area of the coating increased linearly with crystal size. The optical measurements demonstrated that the ability of the coating to absorb light was depended on the thickness of the coating. As the coating became thicker, the absorption increased up to a certain thickness where a saturation limit was reached. Overall, the results from decomposition studies and electrochemical measurements indicated that the thickness of the coating has a profound influence on the photocatalytic properties.