Friction stir processed Al-TiO_2 surface composites: DC vs. High Frequency Pulse and Pulse Reverse Anodising

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High Frequency Pulse and Pulse Reverse Pulse anodising was applied to Al-TiO_2 surface composites and compared with conventional DC anodising. Friction stir processing (FSP) was employed to impregnate TiO_2 powders into the surface of an Aluminium alloy. The aim was to understand the anodising behaviour of the Aluminium composites and to develop optical effects in the anodised layer owing to the presence of incorporated oxide particles that influence the scattering of light. The microstructure, morphology and resulting optical appearance of the anodised surface are investigated. The effect of anodising parameters on the optical appearance of the anodised surface especially the difference between conventional DC, high frequency pulse and high frequency pulse reverse pulse anodising was studied. Characterization was performed using SEM, FIB-SEM, TEM and GI-XRD. The surface appearance was analysed using photospectrometry technique which measures the diffuse and total reflectance of the surface. The appearance of the anodised surface changed from dark to bright upon increasing the anodising voltage. TiO_2 particles in the FSP zone were partially or completely modified during the anodising process. Anodic pore morphology was modified extensively around the TiO_2 particles and cavities were observed at the TiO_2 particle- Al matrix interface depending on the anodising process used. Clear influence of the process parameters like anodic and cathodic cycle voltage is observed and the mechanism of light interaction like scattering and absorption from the anodised surface are modified accordingly changing the anodised surface appearance.

Keywords: Aluminium, TiO_2, Anodising, Pulse anodising, Appearance, TEM