Corrosion studies of laser-cleaned and laser-marked metallic alloys

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Laser cleaning and laser marking have been widely used for industrial applications. For example, laser cleaning of aluminium alloys, based on laser ablation to remove surface contaminations and aluminium oxides, has been considered as a promising method for the preparation of aluminium alloy surfaces prior to joining and welding. Laser marking on metallic alloys, involving surface melting/vaporisation, has been also applied in various environments. Since the thermal effects induced by these laser processes might be sufficient to change surface chemistry and oxide status, corrosion behaviours of the laser-processed alloys would be affected consequently. In this study, we investigated the corrosion behaviours of laser-cleaned AA7024-T4 aluminium alloy and laser-marked 304 stainless steel using potentiodynamic polarisation, electrochemical impedance spectroscopy (EIS) and scanning vibrating electrode technique (SVET). The results showed that the laser-cleaned aluminium surface exhibited higher corrosion resistance in 3.5 wt.% NaCl solution than as-received hot-rolled alloy, with significant increase in impedance and decrease in capacitance, while SVET revealed that the active anodic points appeared on the as-received surface were not presented on the laser-cleaned surfaces. However, the laser-marked stainless steel presented decreased corrosion resistance. Such corrosion behaviours were correlated to the change of surface oxide status measured by transmission electron microscopy (TEM), glow discharge optical emission spectrometry (GDOES) and X-ray photoelectron spectroscopy (XPS), as well as surface morphological observation by scanning electron microscopy (SEM) and laser confocal microscopy.