Surface characterisation and corrosion behaviour of oxide layer for SLMed-316L stainless steel

W.S.W.Harun[a] *R.I.M.Asri*[b] *F.R.M.Romlay*[a] *S.Sharif*[c] *N.H.M.Jan*[d] *F.Tsumori*[e]

[a] Green Research for Advanced Materials Laboratory (GramsLab), Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

[b] Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia, 11800 USM, Penang, Malaysia

[c] Department of Materials, Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

[d] Kulliyyah of Medicine, International Islamic University Malaysia, Jalan Hospital Campus, 25150Kuantan, Pahang, Malaysia

[e] Department of Mechanical Engineering, Faculty of Mechanical Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan

ABSTRACT

The stable oxide layer formed through thermal oxidation (TO) process on selective laser melted 316 L stainless steel (SLMed-316 L SS) substrate surface attested to assists in refining their corrosion resistance and observed to behave relatively inert in physiological conditions. The surface characterisation and corrosion behaviour of the oxidised SLMed-316 L SS are the primary focus of this study. The formation of the oxide layer on SLMed-316 L SS was investigated at constant ambient atmosphere and 700 °C temperature for three different soaking times (150, 200 and 250 h). The surface characterisation of the oxide layer was performed using Field Emission Scanning Electron Microscope (FESEM), Energy Dispersive X-ray Spectroscopy (EDX) and X-ray Diffraction (XRD) to correlate the thickness of oxide layer and surface morphology after the TO treatment. Whereas, the electrochemical analysis was conducted using potentiodynamic polarisation to investigate the corrosion behaviour of the oxide layer. The finding disclosed an increase in the oxide layer thickness formation at prolonged exposure in ambient atmosphere. Also, the TO at 150 h showed an improved corrosion behaviour due to the presence of Fe_2O_3 and Cr_2O_3 layers. However, the extended soaking time showed no improvement towards the corrosion behaviour.

KEYWORDS:

Selective laser melting; 316L stainless steel; Oxide layer; Thermal oxidation; Corrosion behavior; Additive manufacturing