Characteristic investigation of laser thermal oxidation treatment for maskless marking QR codes on SS316 and Ti-64 surfaces

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This study proposed a laser-heating oxidation technology using maskless ultraviolet laser irradiation on the surface of alloys SS316 and Ti-64. The laser-marked surface generated an oxide layer without ablating materials and produced the color change between oxides and raw materials. The laser power, scan speed, and scan spacing were adjusted to mark QR codes for product identification. The tested results demonstrated that a higher laser power, slower scan speed, and lower scan spacing produced a dark oxide layer. This was due to a phenomenon of high thermal accumulation. Furthermore, the image recognition by the smart phone was more stable when the QR code was marked with a scan speed of 60 mm/s and a scan spacing of 40 μm. The marked QR codes for Ti-64 have significantly black colors compared to those for SS316. QR codes on surfaces SS316 and Ti-64 were found to have the ability to recognize as Fa above 156.3 J/cm^2. The elemental oxygen content of SS316 and Ti-64 treated with 625 J/cm^2 was greater than 3.5 and 50.8 times compared to the untreated, respectively. The grain size of SS316 and Ti-64 before and after maskless laser marking does not have a significant change in the lattice structure. The proposed approach can be widely applied in IoTs for manufacturing components that need to use QR codes in conjunction with the barcode reader to quickly manage inventory.

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