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Department of Laser and Optoelectronics Engineering

Evaluation of laser shock peening effect on corrosion resistance of 304 stainless steel based on image processing

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Abstract

One of the methods that employed to improve and evaluate the corrosion resistance of alloys is laser surface treatment. This work improved the mechanical properties of 304stainless steel (304st.st) alloy such as surface roughness, micro-hardness and corrosion inhibition. The elemental composition of all alloy used in this work has been analyzed by using X-Ray Fluorescence (XRF) technique. The samples were cut into circular forms with a diameter of 20 mm and a thickness of 5 mm using a turning machine. Grinding was performed on all with the same roughness grades on SiC papers (800#), followed by the process of examining the samples with optical microscope before and after laser treatment. Microhardness was measured by using a Vickers hardness testing which carried out with a 0.981N load for 15 seconds before and after laser shock peening (LSP) under effect of two conditions laser energy and repetition rate. The results showed that the micro-hardness increased from 180 (before LSP) to 249 (after LSP), with laser energy of 320mJ, and when the energy increased to 920mJ, the micro-hardness increased to 261mJ. The effect of repetition rate as well as the increasing in the repetition rate led to an increase in the micro-hardness. Surface roughness was measured before and after LSP treatment and the average surface roughness before LSP treatment is 0.0505 μm and increased to 0.540 μm after LSP with energy of 920mJ. While the increasing of repetition rate led to an increase in the surface roughness from 0.05µm to 0.96 µm. Polarization approach was used to conduct the corrosion measurements where we note from the results that the corrosion rate decreased from 18mm/year to 1.292 mm/year after LSP and the decrease in the corrosion rate continued to 1.229 mm/year when the laser pulse energy was increased to 920mJ. The increasing in the repetition rate led

to the corrosion rate decreased to 2.17mm/year after increasing the repetition rate to 8HZ, this means that the efficiency of the corrosion inhibiting by LSP was very appropriate. The image processing was conducted for all samples using image J program and for all tests in order to evaluate the effect of the laser on the hardness, roughness and corrosion inhibition. The results showed that there is a good convergence between the practical results and the results obtained from the image processing**.**