Abstract

Two methods which used to improve the corrosion resistance of metals and alloys are laser processing and deposition of nanoparticles by laser. Laser shock processing (LSP) and laser deposition were performed on 304 stainless steel alloys samples to detect its effect on their microstructure and mechanical properties. The samples were prepared by cutting into circular shapes with 20 mm as diameter and 5 mm as thickness of each. The chemical composition of samples was analyzed by SPECTRO MAXx Instruments. The experimental procedure of the LSP is done by using a (1064 nm) as a wavelength, 900mJ as energy and with pulse duration 10 ns produced by Q-switched Nd: YAG laser of (2 mm) spot size in diameter. Also, PLD is done by using second harmonic generation (SHG) (532 nm), (10 ns) pulse duration with pulse repetition rate of (6Hz) and the distance between target and samples is (12 cm) to deposit Al2O3 nanoparticles on the sample surfaces.

The effects of the LSP parameters such as laser pulse energy and number of pulses with doubled distilled deionized Water (DDDW) which used as transparent confining layer are investigated on the surface micro-hardness, surface roughness and corrosion resistance.

The experimental results showed that, the surface roughness and micro-hardness values are both increased in dissimilar values depending on the LSP parameters which used in this project. Also, the surface roughness and micro-hardness values are both increased after PLD of Al2O3 nanoparticles on the sample surfaces. The corrosion rate results showed that the best laser efficiency and corrosion resistance can be obtained under the best conditions of higher number of pulses (250 pulse), high laser energy of (900 mJ) and DDDW equal to (4mm).Also, the best results that get after PLD is obtained with (700mJ) as SHG laser energy, (i.e.532nm as wavelength) and pulse number of (50 shot). All corrosion results were obtained from polarized curves under different LSP parameters. The corrosion rate was investigated in hydrochloric acid with the concentration of 1 M and the immersion time of

20minute at room temperature. The method which used to conduct the corrosion measurements is the polarization method, where the corrosion rate reduce from (CR=28.79mm/y) to (CR=2.37mm/y),(CR=0.069mm/y) after LSP and after PLD, respectively at the optimum results .The optimum laser efficiency during corrosion tests at conditions (energy 900 mJ, number of pulses 250 pulses and DDDW=4mm) was reached to (91.77% with LSP) and (99.76 % with PLD).

In addition, OM, XRD SEM and AFM measurements has been carried out for all samples before and after corrosion test, LSP and PLD.