ABSTRACT

In this research work, laser irradiation induced changes in the structural, surface, mechanical and electrochemical corrosion properties of Vanadium are investigated. The Vanadium specimens (1.5 cm × 1.5 cm), were irradiated by ND: YAG laser under vacuum at different shots (100, 200, 300, and 400). All the specimens were irradiated at constant values of pulse width (6 ns), pulse energy (150 mJ) and repetition rate (10 Hz). Structural properties of pristine and laser irradiated specimens were investigated by using X-ray diffraction analysis. The results revealed the preferred orientation of Vanadium along (200) plane that remain un-affected upon laser irradiation. The crystallite size D was monotonically increased with the increase of laser shots up to 200, and then decreased with increase of laser shots to 400. The similar trend was followed by the lattice strain ε. The average diameter of the laser ablated region decreased with the increase of laser shots. On contrary, the heat affected area around the ablated region was progressively increased with increase of laser shots. The RMS surface roughness of Vanadium increased monotonically with the increase of laser shots up to 400. The surface morphology of the laser-irradiated Vanadium specimens comprised of microcones, cavities, cracks, grooves dips, droplets, ripples, bubbles, micro-pillars, and wave-like structures, etc. The surface hardness followed Inverse Hall–Petch relation, i.e., bigger the crystallite size (30 – 62 nm), larger the surface hardness (166 – 184 HV). The corrosion rate of the specimens irradiated with 100 and 200 laser shots was higher than that of the un-irradiated specimen. However, the specimens irradiated with 300 and 400 laser shots had lower corrosion rate as compared to that of the un-irradiated specimen. It means that the corrosion resistance of Vanadium increases on irradiating the specimens with 300 and 400 laser shots.