Abstract

The effect of laser fluence as well as nature and pressure of background gases on the surface modification and plasma parameters of Mg-alloy has been investigated. For this purpose Nd:YAG laser of wavelength 1064 nm, pulse duration of 10 ns and repetition rate of 1 to 10 Hz has been employed as an irradiation source. In order to explore the effect of laser fluence at constant pressure of 5 Torr, targets of Mg-alloy were exposed in background gases of Argon (Ar), Neon (Ne), and Helium (Ar) for various fluences ranging from 1.3 $J.cm^{-2}$ to 10.47 $J.cm^{-2}$. In order to explore the effect of nature and pressure of background gases, Mg-alloy targets were exposed under different filling pressures ranging from 5 Torr to 760 Torr at constant fluence of 1.3 $J.cm^{-2}$. Scanning Electron Microscope (SEM) has been used to investigate the surface morphology of the irradiated targets. SEM images depict that ripples, ridges, cones, cavities, droplets and islands are formed on surface of irradiated sample. Initially size and density of these structures increase by increasing fluence and pressures and then decrease with further increase in fluence and pressures of background gases. Laser induced breakdown spectroscopy (LIBS) technique was employed to measure electron temperature (T_e) and electron number density (N_e) of Mg-alloy plasma. The value of T_e ranges from 8767 K to 12173 K whereas value of N_e varies $5.39\times10^{17}cm^{-3}$ to $8.62\times10^{17}cm^{-3}$ with variation of fluence from 1.3 $J.cm^{-2}$ to 10.47 $J.cm^{-2}$. Whereas T_e varies from 6692 K to 11882 K and N_e varies from $5.40\times10^{17}cm^{-3}$ to $19.16\times10^{17}cm^{-3}$ with variation of pressure from 5 Torr to 760 Torr. However maximum T_e and N_e of Mg-alloy is observed in Ar and minimum in case of He. It was also found that both T_e and N_e increase with increasing fluence and pressure. With the further increase in fluence and pressure the decrease in both parameters is observed. Afterward a saturation or self-sustained region is achieved in all environments. The hardness and corrosion resistance of irradiated Mg-alloy has been explored by using Vickers Micro hardness tester and Potentio-dynamic polarization technique respectively. It was investigated that as compared to un-irradiated target, the hardness as well as corrosion resistance of laser-irradiated target has been increased significantly in all environments and are strongly influenced by environmental conditions. Plasma parameters, mechanical and electrical properties of laser irradiated Mg-alloy have been correlated with induced surface modifications.