Abstract

The effect of laser irradiation on surface, structural, electrical and mechanical properties of Al alloy 2024 has been investigated. A second harmonics of Q-Switched Nd: YAG laser (wavelength = 532nm, pulse duration = 6 ns and repetition rate = 10 Hz) is used as irradiation source at various laser fluences varying from 0.81 J/cm^2 to 4.1 J/cm^2 under ambient environment of oxygen at a filling pressure of 20 Torr. The surface topography analysis of central ablated areas performed by Scanning Electron Microscope (SEM) confirms the formation of melted channels at the lowest laser fluence which are transformed into indistinct wave-like ridges at increasing fluence. Whereas, irregular shaped structures with enhanced surface roughness are observed at moderate laser fluences. The surface is characterized by the formation of pores, cavities and droplets at the maximum laser fluence. In case of peripheral ablated areas, melted strips with conical branches are observed at lower laser fluences, whereas random structures and splashing are the dominant features at higher laser fluences. XRD analysis confirms the formation of Al_2O_3 phase only at the lowest laser fluence of 0.81 J/cm^2. Whereas, higher laser fluences are responsible for the modifications in peak intensities and shifting of peaks towards higher angular positions. An overall decreasing trend in the crystallite size and increasing behavior in dislocation line density is observed with increasing laser fluence. The increase in residual stresses and strains establishes a good correlation with the modifications in dislocation line densities after laser irradiation. The modifications in electrical and mechanical properties after laser irradiation have been explored by four probe method and Vicker's micro hardness testing technique respectively. A linear decrease in electrical conductivity of laser irradiated Al alloy (2024) is observed with the increase of laser fluence. Whereas, an overall increase in surface microhardness of target is recorded after laser beam irradiation.