Abstract

Modifications to the surface, structural and mechanical properties of brass have been investigated by using three different kinds of radiation sources. The first radiation source was laser, second one was laser induced plasma ions and the third one was Pelletron accelerator. Brass targets were exposed to various laser pulses ranging from 1200 to 3000 of excimer laser (248 nm, 20 ns, 120mJ and 30 Hz) at constant fluence of 6.4 J/cm^2 in oxygen atmosphere (100 Torr). In order to explore the ion induced modification in properties of brass, ions were generated by two different ion sources. The laser induced plasma was employed as a first ion source for the generation of Ni, Si and C ions. Excimer laser (248 nm, 20 ns, 120mJ and 30 Hz) was used for the generation of Ni, Si and C plasma. In order to estimate ion flux and energies, Thomson parabola technique was employed. By using this technique, magnetic field of strength 80 mT was applied on the plasma plume to give appropriate trajectory to generated ions. These ions were detected by solid state nuclear track detector (CR39). In response to stepwise increase in number of laser pulses from 3000 to 12000, the Ni ion flux varies from 60×10^{13} to 84×10^{16} $ions/cm^2$ with constant energy of 138 KeV. Similarly Si ion flux varies from 45×10^{12} to 75×10^{15} $ions/cm^2$ with constant energy of 289 KeV. The flux of C ions flux changes from 32×10^{11} to 72×10^{14} $ions/cm^2$ with constant energy of 678 KeV. The second source of ion generation is Pelletron accelerator. Brass targets were bombarded by Ni and C ions of energy 2MeV for various ions flux ranging from 56×10^{12} to 26×10^{13} $ions/cm^2$. Scanning Electron Microscope (SEM) and X-Ray Diffractometer (XRD) were used to analyze the surface morphology and crystallographic structure of irradiated brass respectively. Universal Testing Machine (UTM) and Vickers Hardness Tester (VHT) were employed to explore Yield Stress (YS), Ultimate Tensile Strength (UTS) and mirohardness of ion irradiated brass targets. SEM analysis reveals the formation of micro/nano sized cavities, bumps, cones and wave-like ridges with non-uniform shape and density distribution after laser irradiations. Whereas, ion irradiation causes the formation and growth of nano/micro sized cavities, pores, pits, voids and cracks for lower and moderate ion flux (in all cases). At maximum ion flux the granular morphology (in case of brass irradiated by laser induced Ni and Si ions) and dendritic morphology (in the case of brass irradiated by laser induced plasma and Pelletron accelerator C ions) are observed.

XRD analysis reveals that no new phases are identified in case of laser irradiated brass. However ew phases of CuZnNi (200), CuSi (311) and ZnC (0012) are identified in the brass substrate ter laser induced Ni, Si and C ions irradiation respectively. Whereas, no new phases are formed case of Ni and C ion irradiation obtained by Pelletron accelerator. The variation in peak tensity, crystallite size, dislocation line density and induced stresses along with angular shifting observed in all cases of laser and ion irradiations. Significant variations in mechanical operties of brass are observed after laser and ion irradiations. The changes in mechanical operties of an irradiated brass are well correlated with surface and crystallographical odifications and are attributed to generation, augmentation, recombination and annihilation of ion induced defects. The laser and ion induced surface, structural and mechanical difications of brass are significantly influenced by nature, energy and flux of radiations.