

ABSTRACT

Ar microplasma irradiation of Ti alloy is investigated for its surface, structural, morphological and mechanical modifications. The irradiation is conducted for different treatment times of 5 minutes, 10 minutes, 15 minutes, 20 minutes, and 25 minutes, utilizing an optimized argon flow rate of 10 L/min and an applied direct current voltage of 5 kV. The ablated crater size and surface morphology are evaluated by using optical and SEM analyses. The formation of pits, bumps, randomly distributed globular structures along with erosion cavities is observed. By increasing the treatment time, the morphology evolves from a continuous embedded wrinkle structures to segregated protruded bump like structures. XRD analysis revealed the Ti alloy retains its overall crystal structures after microplasma irradiation. However, low intensity peak of TiO is observed at higher treatment time due to incorporation of atmospheric oxygen into the lattice. The variation in the peak intensity and higher angular position represent the generation of ion-induced defects and stresses. The mechanical analysis explored by the Vickers microhardness tester revealed that the overall hardness of plasma-treated Ti alloy is increased. However, with increasing treatment time, it initially shows an decreasing trend and then a increasing trend is obtained, which is the reverse of crystallite size. These variations in hardness are well correlated with surface and crystallographic modifications, that are attributed to the generation, recombination, and annihilation of defects induced by plasma treatment.