ABSTRACT

In this work, structural, surface morphology, and corrosion properties of Tungsten were investigated after Nd: YAG laser irradiation. Tungsten samples were irradiated by Nd: YAG laser in oxygen environment (1 torr) at different shots (1, 20, 40, 60 and 80) while maintaining the beam energy (150 mJ) and fluence (4.7 J/cm^2) constant. The structural properties of unirradiated and laser beam irradiated Tungsten were examined by using x-ray diffraction (XRD) technique. The results indicated diffraction peaks of Tungsten along various planes showing preferred orientation along (110). The intensity of (110) was substantially decreased after laser irradiation at 1 shot which was followed by an increase in the intensity of other planes. The intensity of (110) plane remained constant with increase of laser shots up to 60 and then rapidly increased at 80 shots. The intensity of diffraction peaks of Tungsten along other planes followed an opposite trend as compared to the (110). The crystallite size of Tungsten was decreased with increase of laser shots up to 60 and then increased by further increasing the laser shots to 80. The surface morphology of unirradiated and central ablated regions of laser irradiated Tungsten was studied by using scanning electron microscope (SEM). The SEM results revealed the formation of diffusive molten pools and channels due to incomplete melting of the surface at 1 shot. At 20 shots, the surface of laser irradiated Tungsten was characterized by the formation of cracks, diffusive melted channels and flowers like structures attributed to exfoliation sputtering. By increasing the number of laser shots to 40 and then to 60, pores and nano-protrusions were observed. The alignment of ripples was found at 80 shots due to re-solidification process. The electrochemical testing of laser irradiated Tungsten was performed in a Phosphate Buffer Saline solution. The corrosion rate was decreased after laser irradiation at 1 shot, then marginally increased until 60 shots and afterwards it was further decreased with increase of the laser shots to 80. The decrease in corrosion rate was followed by a decrease in the corrosion current density and an increase in the corrosion potential. These changes were explained on the basis of structural and morphological results of Tungsten obtained after the laser irradiation.