ABSTRACT

In this work structural and surface study of carbon ion implanted Mg-Al-Zn alloy (AZ91D) was conducted. The purpose of this study was to investigate the effects of carbon ions implantation on the electrochemical corrosion of Mg-Al-Zn alloy particularly at higher carbon doses (10^{14} and 10^{15} ions/cm^2) with low energy carbon ions (250 keV). The samples of Mg-AZ91D were irradiated with 250 keV carbon ions at different doses, such as 1×10^{13} ions/cm^2, 5×10^{13} ions/cm^2, 1×10^{14} ions/cm^2, 5×10^{14} ions/cm^2 and 1×10^{15} ions/cm^2 at room temperature through Pelletron Accelerator. The changes induced by carbon ions in the structural properties of Mg alloy were investigated by x-ray diffraction method. The Fourier Transform Infrared Spectroscopy (FTIR) was used for the identification of carbon vibrational stretching modes in the irradiated samples. The electrochemical corrosion of Mg-AZ91D alloy was investigated in 0.9% NaCl solution. The potentiodynamic polarization technique was used for measurement of corrosion potential, corrosion rate and corrosion current density. Finally, the surfaces of electrochemically tested samples were studied by the scanning electron microscope. The structural characterizations revealed an increase in the intensity of Mg (002) plane after the carbon ion implantation. Further analysis showed a decrease in the crystallite size of Mg alloy after carbon ion implantation up to 1×10^{13} ions/cm^2 and then increase with further increase of the ion dose to 1×10^{15} ions/cm^2. The structural changes occurred as a result of ion implantation in Mg AZ91D alloy were explained on the basis of ion induced defects and localized heating. The FTIR data indicated C-H, C-O, C=O and C-C vibrational modes in the irradiated samples. The surface morphology of 250 keV carbon ion implanted samples revealed the formation of particulates and agglomers. The open circuit potential (OCP) tests indicated that the OCP does not change at lower ion doses (up to 1×10^{14} ions/cm^2), however, the OCP becomes more positive as the ion dose increases to 5×10^{14} ions/cm^2 and then to 1×10^{15} ions/cm^2. Similarly, corrosion current density and corrosion rate were significantly reduced after carbon ion implantation particularly at 1×10^{15} ions/cm^2. The improvement in the corrosion resistance of Mg alloy with increasing carbon dose is attributed to the formation of Mg/Al carbides on the alloy surface that resists the sample's oxidation. The SEM results of electrochemically tested surfaces also validated the results of potentiodynamic polarization.