ABSTRACT

Magnesium alloy (AZ31) was irradiated with 400 keV silicon ions using Pelltron Accelerator at 10^{13}, 10^{14} and 10^{15} ions-cm^{-2}. X-ray diffraction (XRD) measurements were conducted to analyze the crystal structure, crystallite size and lattice strain in the unirradiated and irradiated material. Micro-hardness testing of the samples was carried out using Vickers hardness tester. Electrochemical analysis of the alloy before and after ions irradiation was done using potentiodyanamic polarization method in NaCl solution. Post-corrosion morphology of unirradiated and irradiated samples was studied through scanning electron microscopy. XRD results showed peaks of Mg along different planes both in the unirradiated and irradiated samples. Before the ions irradiation, intensity of (101) plane was higher than that of the other planes. However, after Si ions irradiation, intensity of (002) plane increased, while the intensity of (002) plane was increased. The average crystallite size of the Mg alloy was increased after Si irradiation up to 10^{14} ions-cm^{-2} and then decreased at the higher dose. The increase in crystallite size at lower doses was attributed to thermal effects of Si irradiation, while at the higher dose, the significant disorder in the crystal structure occurred which resulted in a decrease in the crystallite size of the material. Vickers hardness results showed that the hardness of Mg-AZ31 alloy was decreased on increasing the ion dose up to 10^{14} ions-cm^{-2} and then increased at the higher dose. The corrosion rate and current density of the Mg alloy were decreased after Si ions irradiation until 10^{14} ions-cm^{-2} and then significantly increased at 10^{15} ions-cm^{-2}. The decrease in the corrosion rate was ascribed to an improvement in the crystallinity of the material due to thermal effects of ions irradiation as well as formation of a passive layer. However, structural and surface defects such as vacancies, interstitials and grain boundaries at the higher dose (10^{15} ions-cm^{-2}) resulted in an increase of the corrosion rate and current density of the material. The post-corrosion SEM micrographs validated the electrochemical testing results of the unirradiated and irradiated samples.