Abstract

Mg-alloy (AZ91) is extensively used in medical applications due to its excellent biocompatibility and biodegradability. However, the low mechanical properties and corrosion resistance limit its uses in medical field. In present research work, the thermal plasma irradiation effects for various exposure time ranging from 5 minutes to 25 minutes on surface morphology, structural and mechanical modifications of Mg-alloy AZ91 have been investigated by both optical and SEM analyses, XRD and Vicker hardness along with tensile testing respectively. Optical and SEM analyses show the growth of craters, pores, cavities, bumps, particulates and island like structures on surface of exposed samples, whose density and size increase with increasing exposure time. The growth of these structures is attributed to plasma induced sputtering, surface tension gradients and localized mass evaporation. The micro-hardness, UTS and Yield stress along with dislocation line density initially decrease with increasing exposure time from 5 minutes to 15 minutes and then increase up-to the maximum exposure time of 25 minutes, which are well correlated with initially decreasing and then increasing trend of crystallite size. The variations in mechanical properties are attributed to variation in the density and size of $Mg_{17}Al_{12}$ precipitates as function of exposure time. Our finding is that at lower exposure time AZ91 exhibits the ductile behavior (softening), whereas, at higher exposure time it shows the brittle behavior with enhanced hardness which makes it more suitable for the medical applications, auto industry and aerospace applications.