

ABSTRACT

The present work deals with comparative investigations regarding differences and similarities in accumulating effects of unmagnetized and magnetized Cu plasma ions on surface, structural, optical and electrical properties of PMMA. These effects have been explored by optical as well as Scanning Electron Microscopy (SEM), UV-visible spectroscopy, FTIR spectroscopy and four probe method, respectively. Nd:YAG laser (532nm, 10ns,10Hz, 230mJ) at irradiance of 3.6 GW/cm² was used to generate Cu plasma. The Faraday Cup was used for measurement of fluence and energy of Cu ions, which comes out to be **7.4×10¹² ions/cm²** and **5.1 keV** in the absence of magnetic field, whereas, both ions parameter are enhanced to **7.5×10¹³ ions/cm²** and **6.7 keV** in the presence of magnetic field. These significant enhancements are attributed to magnetic confinement, Joule's heating effect and increased collisional frequencies. PMMA samples were exposed to unmagnetized and magnetized Cu plasma ions using same number of laser pulses ranging from 1000 to 5000. The optical microscopy analysis reveals that un-magnetized Cu plasma ions irradiation causes the growth of pits and pores, whereas, the formation of well-defined dendritic structures with secondary and tertiary arms are observed with ions irradiation of magnetically confined Cu plasma. SEM analysis depicts the formation of protrusions, flakes, cluster, glubules and granular structures on both type of samples i.e. exposed to magnetically confined and unmagnetically confined plasma ions. The size and densities of these observed structures gradually increase with increasing ions fluence. Growth of CuO and Cu₂O phases have been detected after irradiation in both cases, whereas, the intensity of these phases increases with increase in ions fluence. A significant increase in electrical conductivity has been observed at lower fluences, while, at higher ions fluences electrical conductivity starts decreasing due to increase in the formation of copper oxide phases on the samples. Significantly increased values of surface temperature rise, total energy loss and range of magnetically confined Cu plasma ions in PMMA are obtained as compared to unmagnetically confined plasma ions. These values for magnetically confined plasma ions are 1.88×10⁴ K to 5.22×10⁴ K, 64.87 eV/ Å, 146 Å, whereas, for unmagnetized plasma ions these values are 1.73×10⁴ K to 4.82×10⁴ K, 60.32 eV/ Å, 123 Å respectively.