Abstract

The effect of magnetic field on Laser Induced Breakdown Spectroscopy (LIBS) of Aluminium (Al) plasma has been investigated at various laser irradiances as well as pressures of two different environments of argon and neon and at different time delays. Al targets were exposed to Nd: YAG laser (1064nm, 10ns) at different irradiances ranging from 1 to 2.7 $GWcm^{-2}$ under Ar and Ne environments at a pressure of 10 torr with a fix time delay of 1.25 μs. In order to explore the effect of pressure of background gases, the Al targets were also exposed to laser pulses under Ar and Ne environments at pressure variation ranging from 5 to 760 torr. Similarly for investigating the effect of time delay on emission spectra of Al, the time delay was varied from 0.42 to 9.58 μs at a constant irradiance of 1.4 $GWcm^{-2}$ under both environments of Ar and Ne at 10 torr pressure. Two permanent magnets of strength 0.9 tesla were used for the employment of transverse magnetic field on Al plasma. All measurements of laser induced breakdown spectroscopy were performed in the presence and absence of magnetic field. Initially with increasing irradiance both T_e and n_e increase and achieve their maxima at 1.7 $GWcm^{-2}$. With increasing laser irradiances from 1.7 $GWcm^{-2}$ to 2.4 $GWcm^{-2}$ both plasma parameters decrease due to shielding effect. At higher laser irradiance the saturation in both parameters is observed. With the pressure variation again T_e and n_e values increases with increasing pressure and achieve maxima at certain pressures and then start to decrease. At higher pressure ranging from 400 to 760 torr the saturation is observed which is attributed to self-regulating regime. In the case of time delay both T_e and n_e decay exponentially which is according to adiabatic expansion model. The emission intensity T_e and n_e are higher in Ar than Ne environments, which is attributed to higher thermal conductivity and lower cascade growth of Ne than Ar. It is revealed that emission intensity, T_e and n_e values are higher in the presence of magnetic field as compared to field free case. It is true for all laser irradiances, gas pressures of both environments Ar and Ne as well as time delays. This enhancement is attributed to magnetic confinement as well as Joule heating effect. Plasma plume confinement is confirmed by analytical evaluation factor β, which is less than 1 for all cases and therefore confirms the validity of magnetic field confinement.