Abstract

The effect of magnetic field on Laser Induced Breakdown Spectroscopy (LIBS) of Cobalt (Co) plasma has been investigated at various irradiances as well under different pressures of two environments of argon (Ar) and neon (Ne) and at different time delays. Co targets were exposed to Nd: YAG laser pulses (1064nm, 10ns) at various irradiances ranging from 1 to 2.9 $GWcm^{-2}$ under Ar and Ne environments at a pressure of 10 torr with the fix time delay of 1.25μs. In order to explore the effect of pressures of background gases Co targets were exposed to laser pulses under Ar and Ne environments under various pressures ranging from 5 to 760 torr. For investigating the effect of time delay on Co plasma, delays time were varied from 1 to 10 μs at laser irradiance of 1.4 $GWcm^{-2}$ with constant pressure at 10 torr under Ar and Ne. The transverse magnetic field of strength 0.9 Tesla (T) was employed by using two permanent magnets. It was observed that with increasing laser irradiances from 1.1 $GWcm^{-2}$ to 1.80 $GWcm^{-2}$, plasma excitation temperature (T_e) and electron number density (n_e) also increase and achieve their maxim and then start to decrease from 1.80 $GWcm^{-2}$ to 2.16 $GWcm^{-2}$ due to shielding effects. At higher laser irradiances saturation is observed which is attributed to self- regulating regime. Same trends are observed in case of background gas pressures. In case of time delay variation, the Co plasma parameters T_e and n_e decrease exponentially. It was revealed that both plasma parameters are significantly enhanced in the presence of magnetic field as compared to field free case in both environments of Ar and Ne. This enhancement is due to magnetic confinement, adiabatic compression as well as Joule heating effect. It is also revealed that emission intensity, T_e and n_e of Co plasma are higher in Ar than Ne. Which is attributed to lower thermal conductivity and higher cascade growth of Ar than Ne. The plasma plume confinement was confirmed by analytical factor β, which is the ratio of plasma pressure to magnetic pressure. The value of β is less than 1 for all cases which confirms the effectiveness of magnetic confinement.