

Abstract

The influence of external magnetic field (MF) of strength 1 Tesla (T) on the laser induced Ni plasma has been investigated by using the Langmuir probe (LP) technique and electric probe. For the generation of Ni plasma, Nd:YAG laser (532 nm, 6 ns, 10 Hz) at various laser irradiances ranging from 8.6 GW/cm² – 13.2 GW/cm² has been employed under ultra-high vacuum condition (UHV). By using LP, the electronic signals were obtained at various biasing voltages ranging from 3V to 90V whereas, ionic signals were obtained at biasing voltages ranging from -3V to -60V. Plasma parameters such as electron temperature (T_e), electron density (n_e), ion density (n_i), Debye length and electron thermal velocity (v_{th,e}) in the absence and presence of external MF have been evaluated from I-V characteristic. It is discovered that all plasma parameters are enhanced significantly in the presence of external MF. This trend is true at all laser irradiances. The T_e, n_e, n_i, Debye length and v_{th,e} in field free case vary from 14 eV to 20 eV, 2.6×10¹⁴ cm⁻³ to 3.2×10¹⁴ cm⁻³, 0.3×10¹⁶ cm⁻³ to 1.2×10¹⁶ cm⁻³, 1.8 μm to 2 μm and 2.5×10⁸ cms⁻¹ to 3×10⁸ cms⁻¹ respectively. In presence of external MF, these values of T_e, n_e, n_i, Debye length and v_{th,e} vary from 19 eV to 26 eV and 3.1×10¹⁴ cm⁻³ to 3.4×10¹⁴ cm⁻³ 0.6×10¹⁶ cm⁻³ to 1.9×10¹⁶ cm⁻³, 1.9 μm to 2.1 μm, 2.9×10⁸ cms⁻¹ to 3.4×10⁸ cms⁻¹ respectively. The maximum value of all plasma parameters and SGEF are obtained at laser irradiance of 12 GW/cm² in the presence and field free case of MF. Self-generated electric field (SGEF) is evaluated to confirm the formation of double layer structure of Ni plasma. The value of SGEF ranges from 6.9 V/cm to 7.8 V/cm in field free case, whereas, these values are enhanced in the presence of MF and vary from 9.1 V/cm to 10.3 V/cm. The observed enhanced value of plasma parameters in presence of MF is attributed to the magnetic confinement and Joule heating effect