Diagnostics of lead plasmas produced by laser ablation

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The Q-switched Nd:YAG laser operating at its fundamental wavelength (10640 Å), generating pulses of 290 mJ, 7 ns of duration and repeat frequency of 20 Hz, has been used for the ablation of lead targets in vacuum and in (6 Torr, 12 Torr and 24 Torr) argon atmosphere. The laser irradiance on the blank was $2x10^{10}$ Wcm^{-2}, the diameter of the standard crater was 0.5 mm. In order to study the interaction for lead targets, the characteristics of the plasmas produced-laser were examined in detail with the use of time-resolved technique (200 to 6 000 ns, delay from the laser pulse). The spectrum is observed by using a monochromator with a time resolved optical multichannel analyzer (OMA III), that allowed the detection of each spectrum and its digital recording for later numerical analysis. Spectral lines of Pb I, Pb II, Pb III can be observed and the corresponding most intense transitions of the Ar II. Temperatures and electron number densities were determined from the different plasmas generated and in different conditions. Electron number densities are deduced from the Stark broadening of the line profiles for several lines of Pb I, Pb II and Pb III [1-3]. Electron temperatures of the plasmas were determined from the Boltzmann plot and the Saha-Boltzmann equation. For each spectrum the electron number density, excitation temperature and ionization temperature are calculated for each delay time; we found that the values of the electron density are decreasing from 10^{17} to 10^{15} cm^{-3}. The corresponding temperatures were between 25 000 to 6 000 K. A graphical representation of the evolution of temperature and electron number density versus 200 to 6 000 ns delay from the laser pulse is presented. The existence of the local thermodynamic equilibrium (LTE) for each the plasma has been discussed. Also, has been obtained quantitative information on the abundance of the species present in each the plasma.

1. A. Alonso-Medina, Transition probabilities of 30 Pb II lines of the spectrum obtained by emission of a laser-produced plasma *Physica Scripta* 55 (1997) 49-53; 2. A. Alonso-Medina, C. Colón, Stark widths of several Pb III spectral lines in a laser-induced lead plasma *Astronomy Astrophysics* 466 (2007) 399-402; 3. A. Alonso-Medina, Experimental determination of the Stark widths of Pb I spectral lines in a laser-induced plasma. *Spectrochimica Acta Part B* 63 (2008) 598-602.