Two-Temperature Plasmas
Generated by Femtosecond Laser Ablation of Metallic Targets

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Our recent research has focused on the electrical (Langmuir probe) and optical (space- and time-resolved optical emission spectroscopy) characterization of the dynamics of transient plasmas generated by nanosecond, picosecond and femtosecond laser ablation of metallic targets in vacuum [1-4]. The occurrence of two structures with distinct life-times and expansion velocities has been evidenced experimentally and simulated theoretically in the frame of a new fractal hydrodynamic model [1, 2]. The first part of the transient ionic signal recorded by a Langmuir probe presents an oscillatory structure, which has been correlated with the transient current recorded on the target [3, 4].

In the particular case of femtosecond laser ablation of various metallic targets (W, In, Te, Mn, Ni, Cu, Al), the time-dependence of the probe current is discussed assuming a shifted Maxwellian velocity distribution. By applying various probe biasing voltages and current time-integration, the probe volt-ampere characteristics were obtained. Two types of particles (hot and cold) are evidenced as having different temperatures and expansion velocities. An additional positive target biasing gives a residual ion current as consequence of center-of-mass velocity changing, and the probe characteristic is shifted with a constant value. At higher pressure (~10^{-2} Torr), an interesting behavior was observed in the electronic branch of the volt-ampere probe characteristics: periodic drops of the current for specific values of the probe bias. Some hypothesis on the origin of this peculiar behavior will be presented, along with a tentative correlation with the physical properties of the various metals investigated.

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Proposed topic: T8 - Laser plasmas and their applications