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Consideration on excitation mechanisms in a high-power two-jet plasma

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Abstract

The study of excitation mechanisms in the region before the jet confluence of a high-power two-jet plasma used for analysis of different powders has been undertaken. Distribution of excited levels of Fe atoms and ions according to the Boltzmann population was found. Measuring Fe atomic and ionic excitation temperatures showed their considerable difference (≈ 2000 – 2500 K). The effect of argon on line intensities of a wide range of elements was investigated by the experiment with argon covering. A negligible effect of argon covering on line intensities of atoms with ionization energy < 8 eV allows one to assume their predominant excitation by electron impact. The argon participation in excitation of atoms having ionization energy > 8 eV was revealed. This is likely to be due to Penning ionization by metastable argon followed by ion recombination with an electron and stepwise de-excitations. A more pronounced effect of argon covering was observed for ionic lines of investigated elements with total excitation energy ranging from 11 to 21 eV. Penning ionization followed by electron impact is believed to be a probable mechanism for ion excitation. The contribution of metastable argon to excitation processes results in departure from local thermodynamic equilibrium and different atomic and ionic excitation temperatures.

Keywords: Two-jet plasma; Boltzmann population; Excitation temperature; Argon covering; Excitation mechanisms