VI Serbian-Belarusian Symp. on Phys. and Diagn. of Lab. &
Astrophys. Plasma, Belgrade, Serbia, 22 - 25 August 2006
eds. M. Ćuk, M.S. Dimitrijević, J. Purić, N. Milovanović
Publl. Astron. Obs. Belgrade No. 82 (2007), 57-58 *Invited lecture*

EFFECTIVE REGIMES OF LASER PLASMA FORMATION FOR FILMS DEPOSITIONS AND SPECTROCHEMICAL ANALYSIS OF MATERIALS

A. N. Chumakov[1], N. A. Bosak[1], A. M. Kuzmitsky[1], A. M. Petrenko[1], V. V. Shkurko[1], M. Sambuu[2]

[1]Institute of Molecular and Atomic Physics of National Academy of Sciences of Belarus
220072, Minsk, Belarus, e-mail: chumakov@imaph.bas-net.by
[2]Belarussian State University

Abstract. The action of intensive laser radiation on absorbing condensed mediums results in formation of laser plasma which is widely used both for deposition of thin films in vacuum, and for spectrochemical analysis of materials. The method of pulsed laser deposition in vacuum provides obteining of high velocities of condensation up to 10^4–10^8 nm/s with good enough reproducibility of chemical composition of irradiated material in deposited films. However, efficiency of such deposition essentially depends on repetition rate of laser pulses. With increase of repetition rate of laser pulses the conditions of laser plasma formation and its subsequent gasdynamic motion are being modified, that results in change of spatially-temporal distribution of plasma parameters and conditions of films deposition. In present work, the capabilities of effective formation of laser plasma are explored at multi-pulsed high-frequency ($f \leq 50$ kHz) laser action on materials and features of pulsed laser deposition of films and coatings on various substrates in vacuum, including in the presence of external electrical field, are investigated.

It was established on the basis of complex experimental researches and numerical calculations of pulse-periodic laser action on metals and carbon materials that the interaction of individual plasma formations initiate changes of conditions for plasma deposition on a substrate only for repetition rates of laser pulses more than 10–20 kHz in vacuum and 1–5 kHz in atmospheric air. Diamond-like and conductive carbon films on various substrates are obtained experimentally at irradiation of graphite by pulsed solid-state laser generating on 1060 nm wavelength with repetition rates of laser pulses up to 20 kHz. Multiple growth of carbon films deposition velocity is found out for intensities of external electrical field exceeding 3 kV/cm. The dependence of structure and electrical conductivity of deposited coatings on the direction and intensity of external electrical field is established. This

result can find application for deposition diamond-like and conductive carbon films. The new possibilities for development of LIBS technique for material analysis are revealed using double pulse laser action at two wavelengths of laser radiation.