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Insight into plasma multi-structuring and molecular formation phenomena during pulsed laser deposition

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In situ analysis based on angular, space and time-resolved measurements were performed on transient plasmas generated by ns-laser ablation of Ag in various background gases (Ar, O_2 and N_2) by Langmuir probe technique and space- and time-resolved Optical Emission Spectroscopy (OES). The work was focused on understanding the inner mechanism of ablation plasma dynamics by controlling the ionic energy distribution during the deposition process. A distinctive feature of the study is the focus on the floating regime of the probe as time-of-flight measurement tool. Multiple structuring of the Ag laser produced plasmas have been seen. Each feature corresponds to an ionization state of the Ag ions, results confirmed by OES investigations performed along the main propagation axis and discussed in the framework of multiple double layer formation during plasma expansion. Complementary, OES allowed for the spatial and temporal monitoring of visible and UV emission of the plasma. The nature and pressure of each gas influences the emission in a unique manner, which is corelated with the data from the electrical measurements. A special case was found for Ag in O_2 where we observed AgO molecule formation and its impact onto the plasma energy. For each of the investigated conditions used, thin films were deposited and their properties linked with the ones of the plasma. This link is the main purpose of our complex approach as real time measurement and comprehensive control of pulsed laser deposition of thin films remains one of the main goals of the community.

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