Comprehensive study of laser plasma generation using charge current method

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Abstrak

In spite of abundant experimental evidences supporting the viability of the laser induced shock wave plasma model for the explanation of the important features ofthe plasma and the associated spectroscopic characteristics, a controversy on the atomic excitation mechanism in the plasma has remained to be completely resolved. In this study the contributions of the shock wave model and two other most popular models, the electron-ion recombination model and thc electron collision model were thoroughly investigated. For that purpose, a special technique has been developed for the direct detection of the charge current in conjunction with plasma emission measurement dining the laser plasma generation and expansion. The current detection was performed by placing a partially transmitting metal mesh electrode at a distance in front of the sample surface with the sample target sewing as the counter electrode. The electric Held between the mesh and sample surface was set up and varied by applying a variable DC voltage (0-400 Volt) between them. The laser plasma was generated by a YAG laser (64 ml, 8 ns) tightly focused on a Cu target through the mesh electrode in low-pressure surrounding gas. It was found that the charge current time profiles obtained at various gas pressures invariably exhibit a lack of consistent correlation with the emission time profile of the plasma throughout most of the emission period. The result of this study has thus practically eliminated any significant roles ofthe electron-ion recombination and electron collision models in the excitation process. We are therefore led to conclude that the shock wave model proposed earlier is most plausible for the consistent explanation of the secondary plasma emission, while the other two models may have some contribution only at the very initial stage ofthe secondary plasma generation.