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Dynamics Of Polarized Emission From Nanosecond Laser-Produced Aluminum Plasma

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Anisotropic emission from laser-generated plasma has been the focal point for improving the signal-to-noise ratio in laser-induced breakdown spectroscopy (LIBS). However, thorough understanding of the underlying physical mechanisms or atomic processes is not fully known. In addition, the spatio-temporal evolution of anisotropy in dynamic plasma such as laser plasma has not been systematically investigated. In this work, efforts are made to study the dynamic nature of the polarized emission at different spatial locations as well as times [1]. An attempt is being made to interpret the observed effects of polarization with the involved atomic and collisional processes.

Briefly, a pulsed Nd:YAG laser (10 ns) is used to generate plasma from an aluminium sample under a controlled background pressure of 100 mbar with ambient nitrogen. A polarization resolved imaging system coupled with a spectrometer and intensified charge coupled device (ICCD) is used to record the spectral emission features for both polarizations.

The spatial and temporal evolution of the degree of polarization (DOP) shows a dependence on the charge state and a sign reversal with distance from the sample for ionic emission. The observed behaviour of DOP close to the sample appears to be due to self-generated magnetic field. However, far from the sample, as the effect of this magnetic field is diminished, the observed DOP appears to result from the interaction of the plasma with background gas molecules.

We believe this study will provide further insights into the dynamics of polarized emission from laser-generated plasma, revealing novel phenomena with implications for the advancement in LIBS technology and understanding of plasma interactions.

[1] B. R. Geethika, Jinto Thomas, Milaan Patel, Renjith Kumar R. and Hem Chandra Joshi, J. Anal. At. Spectrom. **38**, 2477 (2023).