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(G*) Hyperspectral imaging of a microwave argon plasma jet expanding in ambient air

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Non-equilibrium plasmas at atmospheric pressure are often characterized by optical emission spectroscopy. Despite the simplicity of recording optical emission spectra in plasmas, the determination of spatially resolved plasma properties (e.g. electron temperature) in an efficient way is very challenging.
Hyperspectral imaging is a spectroscopic technique that combines optical emission spectroscopy with 2D optical imaging to simultaneously generate spectral and spatial mappings of optical emission. Using this technique, images are acquired over a wide range of wavelengths with narrow bandwidths, and a 2D spatial mapping of the spectral variation is generated within a reasonable time. Each pixel of the image ends up containing spectral information, and collectively, the pixels form a hyperspectral cube that comprises both spatial and spectral information.
In this presentation, we show spatially resolved optical images of a microwave argon plasma jet expanding into ambient air recorded over a wide range of wavelengths using a hyperspectral imaging system based on a tunable Bragg-grating imager coupled to a scientific Complementary Metal–Oxide–Semiconductor camera. The working principles of the system are detailed, along with the necessary post-processing steps. Further analysis of the spatial-spectral data, including Abel transform used to determine 2D radially resolved spatial mappings, is also presented.
Overall, we will show that the proposed approach provides unprecedented cartographies of key plasma parameters, such as argon and oxygen line emission intensities, argon metastable number densities, and argon excitation temperatures.
Considering that all these plasma parameters were obtained from measurements performed in a reasonable time, Bragg-grating-based hyperspectral imaging constitutes an advantageous plasma diagnostic technique for detailed analysis of microwave plasma jets used in several applications.

Keyword-1

Hyperspectral imaging

Keyword-2

argon microwave plasma jet

Keyword-3

atmospheric pressure plasma

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