Online diagnostics of the production of reactive species in a micropulsed plasma jet

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Following the large growth of plasma medicine in recent years, cold atmospheric plasma sources have been used in different biological applications. From disinfection to cancer treatment, the field is experiencing a rapid development.

The interaction of a plasma with a substrate involves a wide spectrum of phenomena, from highly energetic electrons to reactive oxygen and nitrogen species, to radiation and electric fields. This variety, together with the complexity of biological substrates, prevents a full modelling of the system. Moreover, most of the plasma sources are based on non-equilibrium conditions, which makes the behaviour of the plasma itself hard to fully predict and subject to instabilities. Aiming towards a wide use of the devices, even in clinical environments, it is fundamental to develop real-time diagnostic for immediate feedback to the operator.

Of particular interest in characterizing the source effects are the reactive oxygen and nitrogen species; however, standard methods used for they evaluation, like FTIR or chemical fluorescence, are invasive and not suitable for online implementations. In this work, the possibility of using electrical and optical emission spectroscopy data as a probe for the production of species is discussed. Using a very simple source, a micropulsed plasma jet, and varying both the plasma and the substrate characteristics, the behaviour of our diagnostic is described, and its efficiency evaluated. Data from other diagnostics and for previous studies are compared to evaluate its coherence and estimate predicting power.

The results here reported can act as a proof of concept to perform further studies and improve the described technology.