Laser Guided Coronas and Its Applications

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A corona discharge is, by definition, a gas discharge where the geometry confines the gas ionizing processes to high-field ionization region around the active electrode(s). Corona discharges have found a number of commercial and industrial applications related to chemistry, diagnostic techniques, and electrostatic applications \cite{1}. Corona discharge also plays an important role in the leader initiation process related to lightning. Although laser filament \cite{2} shows successful demonstrations on guiding high voltage discharges and great potential capability to control atmospheric lightning, but it is a challenging project \cite{3} due to insufficient understanding of the interaction between laser plasma channel and high voltage electric field.

In this talk, we present our recent investigations on using femtosecond laser filament to deliver corona discharges. The high voltage corona discharge can be guided along laser plasma filament, and enhanced through the interaction with laser filaments \cite{4}. The nonlinear enhancement of fluorescence from the interaction of laser filament and corona discharging electric field was attributed to the more efficient ionization along the laser filament by a spectroscopic analysis of fluorescence \cite{5}, which is the key process for filament guided corona discharge. The fluorescence lifetime of laser filament guided corona discharge was measured to be several microseconds, which is 3 orders of magnitude longer than the fluorescence lifetime of laser filaments \cite{4}. The newly developed applications using laser filament guided streamer coronas to probe plasma density spatial distributions \cite{6} and to remotely generate ionic wind \cite{7} will be discussed and presented also.

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References

\cite{1} https://en.wikipedia.org/wiki/Corona_discharge


\cite{5} Y Wei, Y Liu, T-J Wang, N Chen, J Ju, Y Liu, H Sun, C Wang, J Liu, H Lu, S L Chin and R Li, High Power Laser Sci. Eng. 4, e8 (2016)

\cite{6} Y Liu, T Wang, N Chen, S Du, J Ju, H Sun, C Wang, J Liu, H Lu, S L Chin, R Li, Z Xu and Zn Wang, Opt. Express 25, 11078 (2017)
[7] S Du, T-J Wang et al., to be published