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Using Spectroscopy and Imaging Techniques to Investigate Bacterial Inactivation Mechanisms by Cold Atmospheric Pressure Plasma Jet

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Cold atmospheric pressure plasma jet (CAPJ) has piqued research interest for its novel antimicrobial properties. In general, CAPJ discharge consists of electrons, ions (positive and negative), excited atoms and molecules, UV, etc., which interact with ambient air to produce reactive oxygen and nitrogen species (RONS). Notably, CAPJ is found to be useful in a wide range of antimicrobial applications, such as sterilization, disinfection, and wound decontamination. Multiple studies have demonstrated that CAPJ effectively inactivates bacteria *in vitro* and *in vivo*. RONS, ions, and electrons are abundant in the CAPJ discharge, incorporating an entirely novel approach to inactivate bacteria [1][2][3][4]. However, the mechanism by which CAPJ discharge inactivates bacteria has not yet been thoroughly examined. Thus, an in-depth study is required to outline the bacterial inactivation pathway and correlate it to the role of CAPJ discharge species.

This talk will present a systematic investigation of the effectiveness of an argon cold atmospheric pressure plasma jet in reducing bacterial load, along with a detailed analysis of the specific mechanism involved in bacterial inactivation. An in-depth analysis was conducted on discharge characteristics, including electrical and species properties. The molecular composition of bacterial cells was also investigated pre- and post-CAPJ exposure using Fourier transform infrared (FTIR) spectroscopy and Raman micro-spectroscopy. Further, the time-varying FTIR spectra were correlated to the bacterial inactivation curve. In addition, transmission electron microscopy (TEM) images of exposed bacteria indicated the incurred damages on cell morphology by CAPJ reactive species. This study's findings would be highly beneficial to multidisciplinary researchers.

Figure 1 illustrates the in-house developed CAPJ system in contact with bacterial suspension and the diagnostic performed to analyze bacterial inactivation pathways.

References

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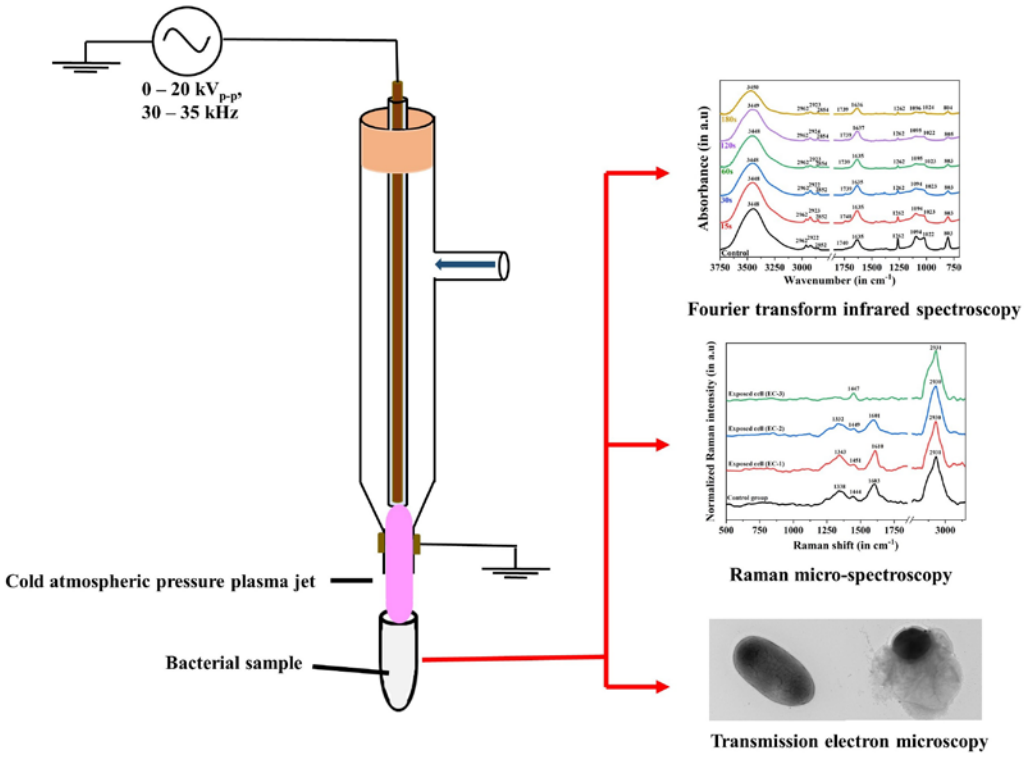

Figure 1 Cold atmospheric pressure plasma jet system in contact with bacterial suspension and the diagnostic performed to analyze bacterial inactivation pathways.