

Production Efficiency of RONS in Plasma Activated Water Improved by Atmospheric-Pressure Microplasma Jet

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Atmospheric-pressure He (or Ar) plasma jet activated water (PAW) also referred to as plasma jet treated water (PTW) is rapidly gaining importance in biomedical applications, particularly for the inactivation of microorganisms. The chemistry of the PAW has been intensively studied by a number of method such as electron spin resonance (ESR), ion chromatography, free radical scavenging activity, Fourier transform infrared spectroscopy (FTIR), and UV-Vis absorption spectroscopy. So far, these works concluded that the various reactive oxygen and nitrogen species (RONS) are existed in the PAW such as $\bullet\text{OH}$, $\bullet\text{NO}$, $\text{O}_2\bullet$, H_2O_2 , NO_3^- , and NO_2^- , and the species are mainly created by an interaction between emerging plasma and ambient air. Therefore the understanding of the gas dynamic can lead us the mechanism of RONS formation in PAW. Previous reports of the gas-surface interaction suggests us smaller plasma jet can generate sufficient RONS and deliver the species to large area [1,2]. In this work, we compare mm- and μ -jets as a view point of the production efficiency η of RONS in PAW. The η is defined as following equation, $\eta = \frac{1}{P_{in}} \frac{1}{G_{in}} T_{abs}$ ($\text{W}^{-1}\text{L}^{-1}$), where P_{in} is input power (W), G_{in} is inlet gas (slm), and T_{abs} is total absorbance in a wavelength between 190 and 340 nm. Figure (a) shows PAW process with mm- and μ -jets. P_{in} of mm-jet is always greater than the case of μ -jet as shown in Fig. (b), while total RONS productions are similar in our calculation in Fig. (c), especially, usage of the He gas is remarkably reduced with μ -jet. Therefore, η with the μ -jet is improved several times as function of the exposure time and further study of the voltage dependency will be reported.

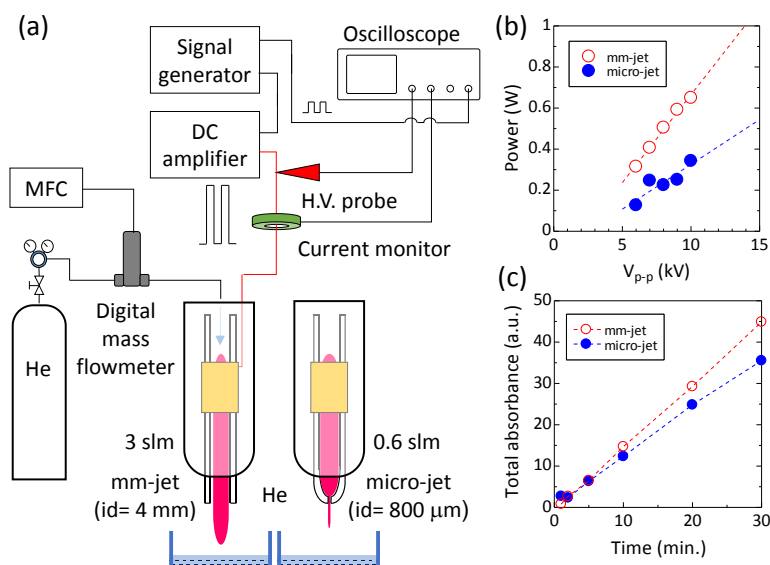


Figure (a) shows an experimental set-up for plasma treated water with a 4-mm-jet or 800- μm -jet, (b) input powers as function of applied voltages between 6 and 10 kV, and (c) total absorbance (or RONS) in PAW at a fixed voltage of 7 kV.

References

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- [2] Doherty *et al*, Plasma Process. Polym. **10** (2013) 978-989