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Effects of pulsed and continuous wave discharges of underwater plasma on *Escherichia coli*

Sang Ju Lee^a, Suk-Hwal Ma^{b,c}, Yong Cheol Hong^{b,d,*}, and Myoung Choul Choi^{a,*}

^a *Mass Spectrometry & Advanced Instrument Group, Korea Basic Science Institute, Ochang Center, Chungbuk 28119, Korea*

^b *Plasma Technology Research Center, National Fusion Research Institute, 113 Gwahang-ro, Yuseong-gu, Daejeon, 305-333, Korea*

^c *Department of Applied Plasma Engineering, Chonbuk National University, 567 Baekje-daero, Deokjin-gu, Jeonju 561-756, Korea*

^d *NPAC, 169-148 Gwahak-ro, Yuseong-gu, Daejeon 305-806, Korea*

* *Corresponding author: Tel.:+82-43-240-5131; Fax:+82-43-240-5159*

E-mail address: cmc@kbsi.re.kr and [ychong@nfri.re.kr](mailto:yhong@nfri.re.kr)

ABSTRACT

In order to deactivate food-borne pathogens, such as *E. coli* O157: H7, in water, *E. coli* bactericidal testing was conducted using pulsed discharge plasma, continuous wave (CW) discharge plasma, and a hybrid discharge of both pulsed and CW plasma. The pulsed discharge instantaneously destroyed the *E. coli* cell wall by the shock wave and the UV radiation generated by the 10 MJ of pulse energy, while the CW discharge plasma sterilized the *E. coli* by free available chlorines (FAC), oxidizing agents, and active species. We determined the best disinfection conditions so that the hybrid discharge plasma could kill more than 99.9999% of the *E. coli* within 15 s. The outer wall of the *E. coli* are damaged by the shockwave generated by the pulsed discharge plasma, which leaves them exposed to attack by the FAC generated by the CW discharge plasma. Transmission Electron Microscope (TEM) images obtained from the cryo-bio-TEM installed at the Korea Basic Science Institute show the *E. coli* before and after treatment by pulsed plasma, and the damage trends at different time intervals. The *E. coli* treated for 30 s with the plasma exhibited a rough surface and irregular shape. After 240 s, the outer wall, membrane, and inner cell of the *E.*

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