The aqueous reactive species induced by asurface air discharge and their sterilization mechanism

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The plasma-activated H_2O_2 solution wasfound to have much stronger antibacterial effect than the plasma-activatedwater. Interestingly, when the H_2O_2 solution withoutplasma activation was mixed with the S. aureus suspension, a large amount ofbubbles were produced but nearly no antibacterial effect was achieved. Incontrary, when the H_2O_2 solution after 4 min plasmaactivation was mixed with the S. aureus suspension, nearly no bubble wasproduced but the colony-forming units of the bacteria was reduced by more than sixlogs. In order to elucidate the underlying mechanism of the interestingphenomenon, several aqueous reactive species induced by the plasma weremeasured, including the long-lived ones such as NO_2^-, $NO_3^-$and H_2O_2, and the short-lived ones such as OH, O_2^-,$ONOO^-$ and O_3. Also, a numerical model was developed forthe plasma-liquid interaction, in which dozens of aqueous reactive species weresimulated. The concentration trends of aqueous reactive species obtained wereobtained by measurement and simulation during the discharge and post-dischargeprocesses, which were used to compare with the trends of bubble amount andantibacterial effect. It was deduced that the aqueous peroxynitrate (O_2NOOH)was possibly the key species to inhibit catalaze, lowering the bubbleproduction as well as enhancing the antibacterial effect in the plasma-activatedH_2O_2 solution.

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