Generation of pulsed discharge plasma in water with fine bubbles

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Nagoya University, GOTO LABORATORY TEAM — Recently, some researchers
have proposed electric discharge methods with bubbles in water because the dis-
charge plasma inside bubble was easy to be generated compared to that in water.
Almost all of these methods introduced bubbles in the order of millimeter size from
a nozzle placed in water. In these methods, bubbles rose one after another owing
to high rising speed of millibubble, leading to inefficient gas consumption. We pro-
posed fine bubbles introduction at the discharge area in water. A fine bubble is
determined a bubble with less than 100 \( \mu \text{m} \) in a diameter. Fine bubbles exhibit
extremely slow rising speed. Fine bubbles decrease in size during bubble rising and
subsequently collapse in water with OH radical generation. Therefore, combining
the discharge plasma with fine bubbles is expected to generate more active species
with small amount of gas consumption. In this work, fine bubbles were introduced in
water and pulsed discharge plasma was generated between two cylindrical electrodes
which placed in water. We examined effects of fine bubbles on electric discharge in
water when argon or oxygen gas was utilized as feed gas. Fine bubbles enhanced
optical emission of hydrogen and oxygen atoms from \( \text{H}_2\text{O} \) molecules, but that of
feed gas was not observed. The formation mechanism of \( \text{H}_2\text{O}_2 \) by electric discharge
was supposed to be different from that with no bubbling. Dissolved oxygen in water
played a role in \( \text{H}_2\text{O}_2 \) formation by the discharge with fine bubbles.

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