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Evaluation of Rotational and Vibrational Temperature of Nanosecond Pulsed Surface Discharge on Water

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In recent years, surface discharge on water has received attention as one of the wastewater treatment method. Discharge plasma can produce OH radicals without secondary product, and the electrode setup of the surface discharge allows a reduction in water pollution from electrode by erosion. Generally, the heating of discharge channel is suppressed by application of short pulse width voltage. Therefore, nanosecond pulsed surface discharge leads to effective generation of OH radicals. However, up till now relatively few studies have been reported on temperature evaluation of the surface discharge on water. In this study, we focused on the temperature of nanosecond pulsed surface discharge on water, and evaluated rotational and vibrational temperature of the discharge from its emission spectrum.

The air gap between the needle electrode and the water surface was set at 1 mm and water depth was set at 10 mm. The distilled water was used in this experiment and the initial value of conductivity of the water was 1.47 uS/cm. The voltage with pulse width of approximately 70 nanoseconds by Blumlein line was applied to the needle electrode. The emission spectra from the discharge was observed by the multi-channel spectrometer. The measurement position of the emission spectra was set just below the needle electrode. The rotational and vibrational temperature were evaluated from the N2 second positive system band (1) (2). The simulation results were in good agreement with experimental results. As a result, the rotational temperature was about 1000 K and vibrational temperature was about 3000 K.

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