# In-situ UV absorption spectroscopy of ozone in gas phase and in water

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Using an in-situ UV absorption spectroscopy, we measured UV absorption spectra of $O_3$ in the both gas and liquid phases. The analysis of UV absorption spectra indicated the generation of $H_2O_2$ and $O_2$ with $O_3$, and the concentration $O_2$ in the early stage played an important role in generation of $O_3$.

## 1. Introduction

Ozone ($O_3$) is a well-known molecule as a strong oxidant and it can be generated by $O_2$ flow (and / or air) through electrical discharge. [1] In recent, $O_3$ is getting important in many applications including life science as well as the traditional water treatment, air cleaning, semiconductor and industry. [2]

For the measurement of the absolute concentration of $O_3$ is well established based on the light absorption technique for measuring an absorbance at a fixed wavelength. It is common that the measurements of the both gaseous $O_3$ and $O_3$ in water associate with a UV at 254 nm from a mercury lamp. Also, a combination of a chemical probe and a LED light for detecting the change of color at a fixed wavelength is open used for dissolved $O_3$ in water. However, these methods unable to support sufficient information to understand the composition of species in gas or liquid.

Here, we used a traditional method of UV absorption spectroscopy to detect $O_3$ and other species in gas and water. Also, we will discuss the evolution of $O_3$ generating process using in-situ measurement.

## 2. In-situ UV absorption spectroscopy

A conventional UV-Vis spectrophotometer (U-3900, Hitachi) was used for detecting $O_3$ in the both gas and liquid phases (in Fig.1). $O_3$ generated through an $O_2$ creeping discharge and delivered into a quartz tube[1] for gaseous $O_3$ or a quartz cuvette for $O_3$ in water. Fig. 2 shows the absorption spectra of stable $O_3$ measured in the both phases. It noted that the spectrum of $O_3$ in water (or ozonated water) has the absorption peak at slightly longer wavelength of 260 nm and shows an absorption shoulder at short wavelength range below 220 nm as compare to the spectrum of gaseous $O_3$. [3] Form the analysis of in-situ measurements of $O_2$ plasma bubbling in water for 12 min, we found that there are much high concentration of $H_2O_2$ (42 mg/L) and $O_2$ (3 mg/L) with $O_3$ (9 mg/L). Also, the concentration of dissolved $O_2$ in water played an important role in generation of $O_3$ at an early stage.

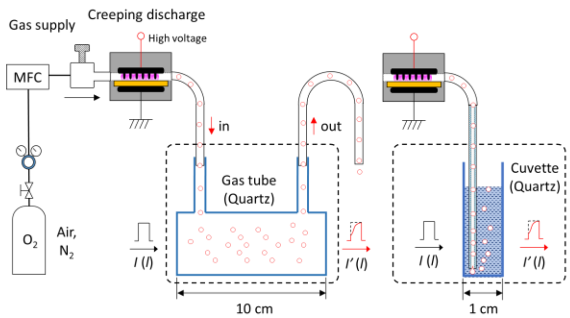


**Fig. 1**: *Schematic of the experimental set-ups to monitor the gas phase $O_3$ (lhs) and $O_3$ in water (rhs).*

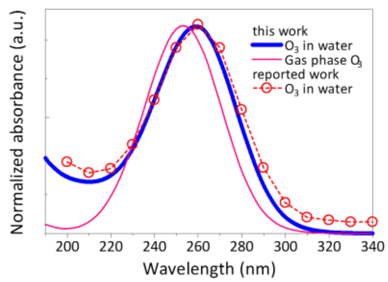


**Fig. 2**: *UV absorption spectra of gaseous $O_3$ and dissolved $O_3$ in water with a reported spectrum.*

## References

[1] I. Somiya, Ozone Handbook, Japan Ozone Association, Tokyo (2004) in Japanese.

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[1] Quartz tubes for detecting gaseous reactive molecules were provided by Mr. S. Shioya and Mr. T. Hayakawa of ORC Manufacturing Co. Ltd.