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Plasma-water systems studied with optical diagnostics including sum-frequency generation spectroscopy

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Recently, various applications of plasma-water systems have been reported, such as materials synthesis, agricultural applications, and medical treatments. As one of basic studies of such systems, we are investigating water surface structure influenced by a plasma via vibrational sum-frequency generation spectroscopy. Vibrational sum-frequency generation spectroscopy is known to be an interfacially active diagnostic technique, as such process occurs in noncentrosymmetric medium. Visible and wavenumber-tunable infrared beams are simultaneously irradiated to the interface. The interfacial water has ice-like (˜3200 cm–1), liquid-like (˜3400 cm–1), and free OH (3700 cm–1) structures (assignment of the ice-like structure still remains contentious), and the intensity of the signal becomes stronger when the tunable infrared beam resonates with a vibration of the structures. The results indicate that with generating air dielectric barrier discharges for supplying reactive species to the water surface, all investigated signals originating from the above-mentioned three structures decrease. Furthermore, the signal strengths are recovered after terminating the plasma generation. We currently believe that the surface density of the reactive species should be high when they are found at the water surface. Details on the experimental results of the sum-frequency generation spectroscopy, as well as other spectroscopic results of plasma-water systems, will be presented at the conference.