EFFECT OF PLASMA GASES ON OH RADICAL GENERATION IN ATMOSPHERIC PRESSURE MICROWAVE PLASMA JET USING UV CAVITY RING DOWN SPECTROSCOPY*

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OH radical plays an important role in biomedical, material, and combustion processing as well as in many other applications. Quantification of OH radicals in atmospheric pressure microwave plasma jets can be useful for understanding of OH formation mechanism and plasma generation. As reported previously, OH radicals exist in the far downstream (distance / plasma column length > 3) of an atmospheric pressure argon plasma jet. So far, we have confirmed that the similar phenomenon also exits in helium plasma jets, N_2 or O_2 mixed with argon plasma jets, and N2 or O_2 mixed with helium plasma jets. Here, the plasma column, which was generated using a microwave plasma source of 2.45 GHz, was typically of 3 mm long. Effects of addition of nitrogen and oxygen gases to argon in different mixing ratios, such as Ar: N_2 = 56:1, Ar: N_2 = 24:1, Ar: N_2 = 13:1 and Ar: O_2 = 27:1, were studied in detail using CRDS, OES and visual imaging. With addition of N_2 in argon plasma, a plume tail appears in the plasma jet column while addition of O_2 makes the plasma column unstable and more like a plume instead of a jet shape. Spectral simulations of emission spectra observed under various circumstances and temperature measurements clearly indicate that the gas temperature of Ar + N_2 plasma is higher than that of Ar + O_2 plasma. Absolute number densities of OH ($v'' = 0$, $J'' = 3.5$) along the plasma jet column were measured in these plasma jets. Dependence of absolute number density of OH on plasma power and gas flow-rate (variation in mixing ratios of N_2 and O_2) were also studied. The similar studies were carried out for addition of N_2 and O_2 in helium plasma jets with the mixing ratios of He: N_2 = 44:1 and He: O_2 = 41:1, respectively. As helium plasma jets are more stable, addition of N_2 or O_2 changes the jets into an unstable jet and a plume-like plasma, respectively. The results suggest that the addition of N_2 and O_2 in argon and helium plasma jets is helpful for OH radical generation but also makes the plasmas less stable.

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