

Abstract Submitted
for the GEC14 Meeting of
The American Physical Society

Ion densities of CH_2F^+ and CHF_2^+ generated by dissociative ionization of charge exchange collisions in Ar or Kr diluted CH_2F_2 Plasmas MAKOTO SEKINE, YUSUKE KONDO, YUDAI MIYAWAKI, KENJI ISHIKAWA, TOSHIO HAYASHI, KEIGO TAKEDA, HIROKI KONDO, MASARU HORI, Nagoya University, PLASMA NANOTECHNOLOGY TEAM — Hydro-fluorocarbon gas, $\text{CH}_x\text{F}_{4-x}$ is used for SiO_2 and Si_3N_4 etching, where the reduction of F in molecule leads high selectively. High selectively were reported as using hydro-fluorocarbon gases having more molecular mass such as C_5HF_7 [1]. H reacts to N and removes it from Si_3N_4 . Therefore H works as an etchant of Si_3N_4 . By using CH_2F_2 gas as an addition of conventional process, high selectively was obtained [2]. In order to understand the etch mechanism for the CH_2F_2 containing plasma, we investigate the gas phase species and reaction to produce etchants. In many cases, multiple fragmentation of the parent gas is suppressed by dilution of large amount of rare gas (M). Besides, dissociative ionization of charge exchange collisions, $\text{CH}_2\text{F}_2 + \text{M}^+ \rightarrow \text{CH}_2\text{F}^+ + \text{F} \cdot + \text{M}^*$ and $\text{CHF}_2^+ + \text{H} \cdot + \text{M}^*$ (M=Ar, Kr) has not been clarified yet. Here we show that the CH_2F^+ ion was dominant in the Ar-diluted plasma, because the channel of resonant dissociative ionization between Ar^+ (ca. 15.8 eV) and C-F bonding cleavage (ca. 15.6 eV) became dominant. In contrast, for the Kr-diluted plasma, similar exchange between Kr^+ (ca. 14.0 eV) and C-H bonding cleavage (ca. 13.9 eV) generated dominantly CHF_2^+ ion. This behavior in the fraction of ion densities in the CH_2F_2 plasma affects significantly to the selectivity.

[1] Y. Miyawaki, et al., J. J. Appl. Phys. 52 (2013) 016201.

[2] M. Darnon, et al., J. Vac. Sci. & Tec. B24 (2006) 2262.

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Date submitted: 13 Jun 2014

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