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Mechanism of Highly Selective SiO_2 Etching over Si using New Alternative Gas, C_5HF_7 YUDAI MIYAWAKI, KEIGO TAKEDA, HIROKI KONDO, KENJI ISHIKAWA, MAKOTO SEKINE, MASARU HORI, Nagoya University, ATSUYO YAMAZAKI, AZUMI ITO, HIROKAZU MATSUMOTO, ZEON CORPORATION — Highly selective etching of oxide for a high aspect ratio contact hole formation is important technologies of IC fabrications. To realize an extreme high etch performances for the future devices, it is important to control the plasma chemistry based on the feedstock gas selection and internal parameters of the plasma. We achieved that highly selective etching of SiO_2 against Si using a newly-designed gas, C_5HF_7, O_2, and Ar gas mixture employed a dual frequency capacitively coupled plasma (CCP). For the conventional $C_5F_8/O_2/Ar$ plasma, the SiO_2 etch rate and maximum selectivity were 453 nm/min and 9.4. In contrast, for the newly developed $C_5HF_7/O_2/Ar$ plasma, the maximum selectivity of 57.3 with the etch rate of 445 nm/min was obtained. Gas phase diagnostics were conducted for understanding the plasma chemistries. It was found the density of F radical (Si etchant) in C_5HF_7 plasma was lower than that of C_5F_8 plasma and appreciable amount of H containing species exist in C_5HF_7 plasma. It is considered F content in the CF film on Si was reduced by the H containing species and lower F radical supply, and then the Si etching was prevented. Consequently, $C_5HF_7/O_2/Ar$ chemistry has a great potential for highly selective SiO_2 etching over Si.

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