A comparative study of $CF_4$, $C_4F_8$ and $C_7F_{14}$ plasma for dry etch processing

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Perfluorocarbon (PFC) precursors having high C/F ratioare used in many semiconductor dry etch processes. Especially, $CF_4$ and $C_4F_8$precursors are generally used in high selective etching of dielectric materialssuch as $SiO_2$ and $Si_3N_4$. However, these PFCprecursors are known for causing global warming effects because of having highglobal warming potentials (GWP) and life times. In addition, These gas typeprecursors released after etch processing are difficult to recover and cause manyenvironmental problems. Therefore, investigation of new liquid type PFC precursorsthat can replace them is very important in semiconductor industry.

In this study, we etched $SiO_2$ and $Si_3N_4$using $CF_4$ and $C_4F_8$, and using perfluoromethylcyclohexane($C_7F_{14}$) which is in liquid state at room temperature. Tovaporize liquid $C_7F_{14}$ easily for the etching, a bubblertype canister, heated gas lines to a constant temperature, and He as a carriergas of $C_7F_{14}$ were used for the etching using an ICPetcher. The gas flow of vaporized $C_7F_{14}$ kept constant usingMFC controller. Then, We compared $SiO_2$ and $Si_3N_4$etch characteristics, such as etch rate, etch selectivity, in various processingconditions, 13.56 MHz ICP power, bias power, operating pressure, and additionalgases for optimized etch conditions.

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) and the Ministry of Trade, Industry & Energy(MOTIE) of the Republic of Korea (No. 20172010105910).