Synthesis and characterization of hydrofluoroether as an environmentally friendly replacement of perfluorocarbon gases in etching process

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Fluorinated gases have been extensively used in the semiconductor manufacturing processes such as chamber cleaning and etching. Examples of such gases include fully fluorinated compounds (CF_4, C_2F_6, C_3F_8, NF_3, and SF_6) and partially fluorinated compound (CHF_3). Unfortunately, these compounds typically have long atmospheric lifetimes and efficiently absorb infrared radiation, which contributes to greenhous effect. Therefore, various means to reduce the emissions of such gases to minimize their environmental impact is currently explored in the related industries. While such attempts have included process optimization, abatement, recovery/recycle, the use of new compound may be the most logical long term solution. For the purpose of replacement of fluorinated gases having high global wariming potentials in etching process, hydrofluoroether compounds have been regarded as a potential candidate. In this study, we will discuss the synthesis of heptafluoroisopropyl methyl ether (HFIPME, $(CF_3)_2$ CF-O-CH_3, GWP=340) and its utilization as a plasma etchant. HFIPME is synthesized from hexafluoroacetone (HFA) and dimethylsulfate in the presence of metal fluoride. Synthesized HFIPME is characterized by gas chromatography, mass spectroscopy, fluorine nuclear magnetic resonance and proton nuclear magnetic resonance spectroscopies. The boiling point and vapor pressure are analyzed using the method described in OECD test guidline 103 and 104. Finally, the preliminary study on the utilization of HFIPME in plasma etching process is carried out.