A CONTROL OF SULFUR HEXAFLUORIDE BY ELECTRON-BEAM

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Introduction

Sulfur hexafluoride (SF_6), with a molecular weight of 146.07, is colorless and odourless. It has an electrical characteristic that makes it applicable to the semiconductor industry and electrical equipment. Also, it has a global warming potential (GWP) of 22,450 times that of CO_2 and an atmospheric lifetime of 3,200 years [1-2]. Therefore it is strongly necessary to destroy SF_6 gas from industrial processes owing to a greater amount of SF_6 gas emissions into the atmosphere. This paper shows the experimental results for the destruction of sulfur hexafluoride (SF_6) by Electron-Beam (EB) irradiation. The all possible destruction mechanism of SF_6 gas is shown below in Figure 1.

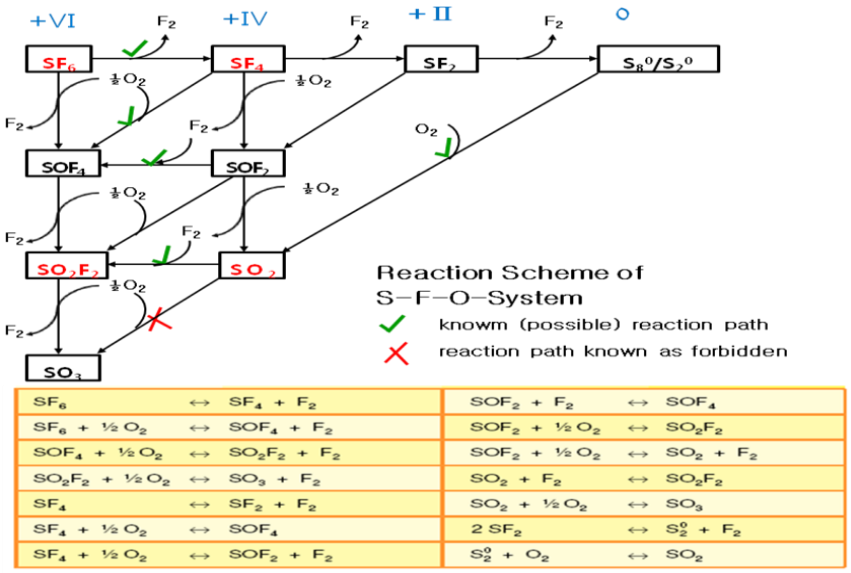

Figure 1. The mechanism of toxic SF_6 gas [3)]

Materials and methods

The experiments were conducted in a batch type reactor, with a capacity of 15.3L with SF_6 of 1000 ~ 2500 ppm. The electron beam was generated with an ELV-4 type (EB-Tech Co, LTD, Korea) with an 1 MeV, a 40 mA current, and 40 kW power of a commercial scale accelerator. The applied electron-beam currents were 2 mA, 5 mA, 10 mA, 15 mA and 20 mA. The analytical techniques used for this study included GC (Gas Chromatography, 7890N, Agilent Technology) and FTIR (MIDAC i4001). Experimental conditions and setup are shown in Table 1 and Figure 2, respectively.

Table 1. Experimental conditions.

Contents	Experimental conditions
Current (mA)	2, 5, 10, 15, 20
SF_6 Conc. (Batch-type)	N_2 : 15.3 L SF_6 : 1000 – 2500 ppm (15.3 – 38.25 ml)
Reactor specifications	Capacity : 110*690*202 mm (15.3 L) Residence time : 18.4 sec Reactor temperature : 0~400 ℃

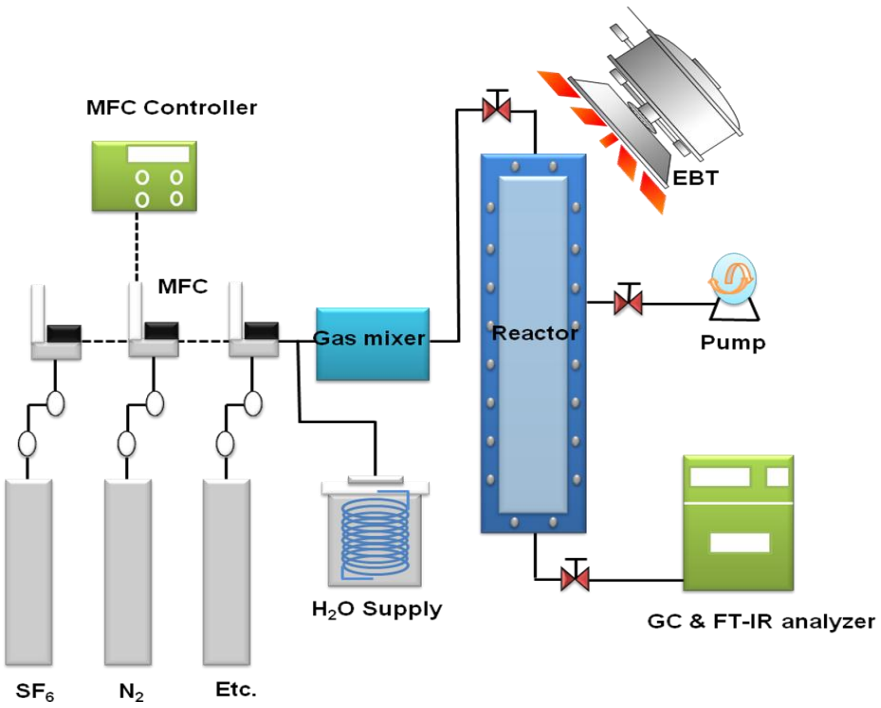

Figure 2. Experimental Setup

Results and discussion:

Figure 3 shows the average DRE(%) of SF_6 gas for electron-beam currents. Applied electron beam currents were 2 mA, 5 mA, 10 mA, 15 mA and 20 mA , respectively. The concentrations of SF_6 gas were 1,000ppm, 2000ppm and 2500ppm. As the concentration of SF_6 gas increased, the average DRE(%) of SF_6 gas was decreased. When 2mA of beam current was applied, the average DRE(%) of SF_6 gas were 30%, 59% and 78% for 2500ppm, 2000ppm and 1000ppm. At 5mA, the average DRE(%) of SF_6 gas were 75%, 90% and 93%. . This result shows that 5 mA of beam current increased drastically DRE(%) of SF_6 gas compared to 2 mA. Over 5mA of beam current, , the average DRE(%) of SF_6 gas were almost constant.

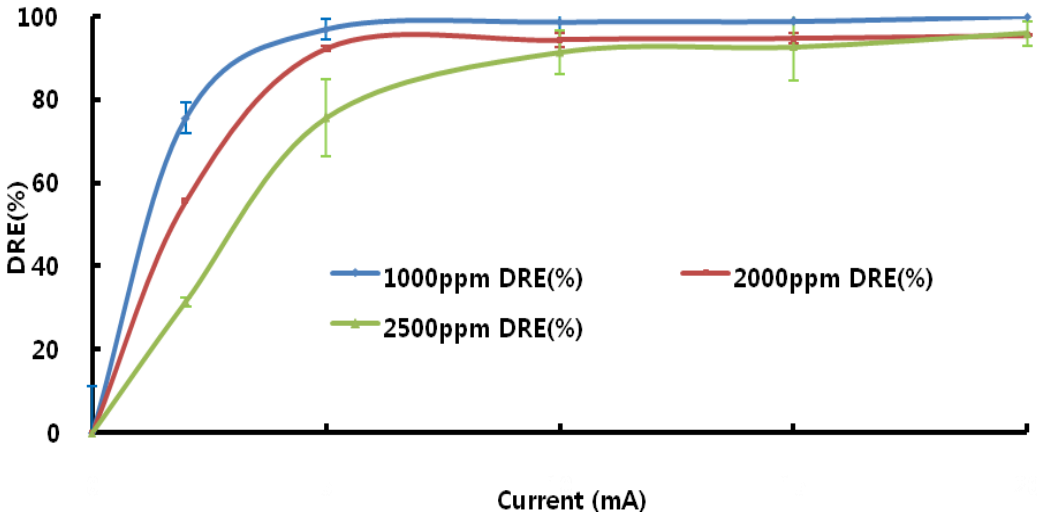

Figure 3. NF_3 DRE(%) with dose only

Acknowledgements:

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References:

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