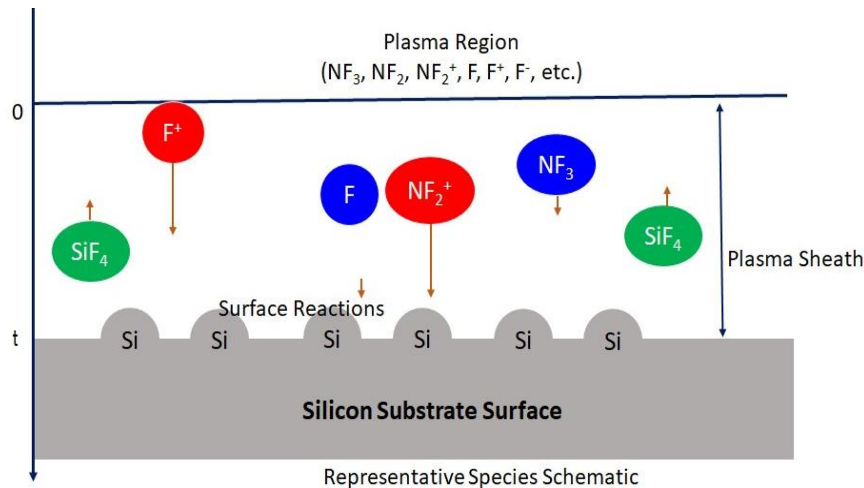
Simulation of silicon etching in NF3 plasma reactor ($^1/_2$)

H.L. Swami, V Mehta, Yogendra Kumar, Chetan Jariwala, Rajesh Kumar



Plasma interaction with silicon substrate

In plasma etch process, reactive species in plasma interact/react with the solid surface and generates volatile species, which come out from the surface easily. The plasma etch process is widely used in various commercial applications such as semiconductor device manufacturing, vertical nanostructure arrays (VNA), surface cleaning, etc.

NF3 gas dissociation energy is lesser than the CF_4 and SF_6.

The NF_3 Plasma reactions have various type of reactions such as ionization, excitation, dissociation, attachment and third body driven reactions. The gas-phase species of NF_3 plasma are F, F_2, NF, NF_2, NF_3, N, N_2, N_2F_2, N_2F_4, NF_3^+, NF_2^+, NF^+, N_2^+, N^+, F_2^+, F^+, F^-.

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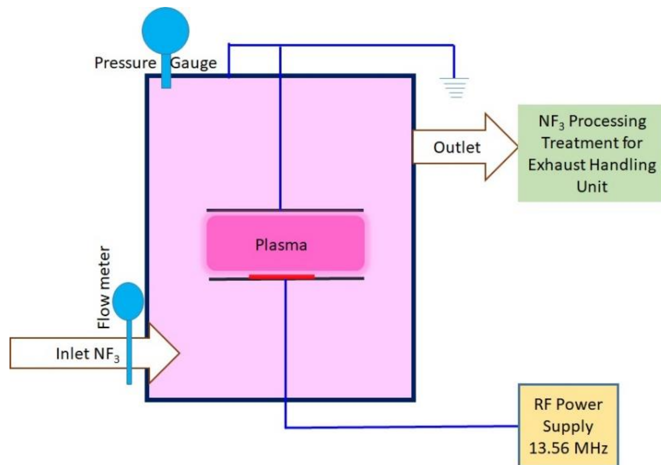
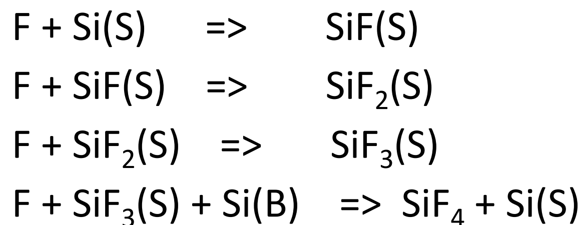


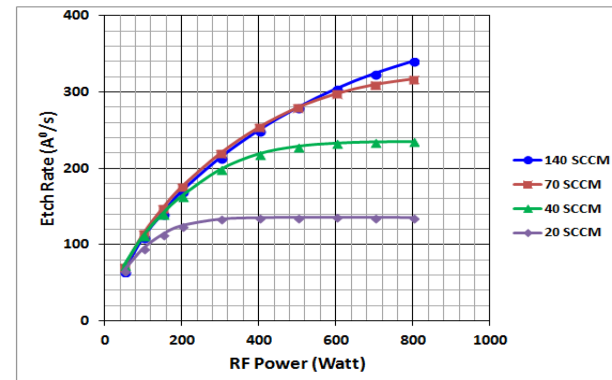
************Add Caption***********



$$F + Si(S) \Rightarrow SiF(S)$$
$$F + SiF(S) \Rightarrow SiF_2(S)$$
$$F + SiF_2(S) \Rightarrow SiF_3(S)$$
$$F + SiF_3(S) + Si(B) \Rightarrow SiF_4 + Si(S)$$

Silicon etch reactions

- A simulation has been conducted for the NF_3 plasma reactor for silicon etching.
- The simulation basic principle depends on the flow dynamics and occurrence of chemical reactions.
- It is done using the CHMIKIN software. The simulation has been carried out for the variation in pressure, flow rate and power deposition.



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