1. Introduction

Advantages of SiC:
- High temperature applications: because of the existence of wider bandgap (three times higher than Si).
- High power application: high avalanche breakdown electric field.
- High frequency applications: SiC has higher electron saturation velocity comparing to Si.

Advantages of Trench structure in devices:
- SiC Trench MOSFETs: have attracted the attention of the industry in recent years because of 1) lower on resistance by eliminating the JFET effect which exists in lateral MOSFETs and 2) higher channel density and 3) minimizing the required surface area because of the vertical channel.
- Trench MOS barrier schotky diodes: have lower forward voltage drop.
- Etched junction termination (JT): helps to achieve up to 90% of the idea parallel plane junction breakdown voltage without the need for implantation and annealing at high temperatures.

2. How to fabricate the device?

- Example of etching trenches for gate of the device:

  Challenges: Finding the optimum recipe with right pressure, power, temperature, gas combination or the result is:
  - Micro Trenches: lower breakdown voltage
  - Etch away the protection Mask: no vertical trenches
  - Rough walls: slower switching, less energy efficient

3. Results

The effects of etching using SF6 and O2, and Ar, where the gas ratio, pressure, ICP and RF power and masking material are varied on microtrenching, striation, side angle and smoothness are studied.

Using O2 in the SF6 gas combination is shown to increase the microtrenches, whilst addition of Ar reduces the size of microtrenches. Lower ICP power (Fig. 2) and pressure (Fig. 4) can help to eliminate microtrenching but results in decreasing etch rate and also increasing the sidewall roughness.

An alternative method to remove microtrenching is via changing the mask materials to one with a higher etch selectivity thus shielding the trench side wall [Fig. 5] regardless of the etching parameters used.

4. Conclusions

We have presented a brief summary of the challenges faced when designing a SiC trench structure. During this three year project each issue is studied in detail to improve the existing solutions. The ultimate goal of these improvements is to achieve optimized trench structure and also study the isolation layers in trench structure using Trench devices such as trench MOS capacitors.