

## The Effect of Irradiation and Temperature on the Restrahlen Shape of 3C-SiC Reflectance IR Measurements: A Preliminary Study.

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#### Agenda

- Background
- Irradiation effects on IR spectra
- Conclusion
- Acknowledgements



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#### **Background: Introduction**

- IR as SiC characterization technique is well known for semiconductor applications
- SiC as functional and structural materials for Nuclear application has spiked new interest in IR as characterization technique
- IR spectra provides information on optical parameters & electrical properties (layer thickness, carrier concentration, mobility)
- Restrahlen band is influenced by surface roughness & porosity
- Previous work was conducted : grain size, surface roughness, P-doping

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 This work: Please note that full interpretation is not completed and results/conclusions are preliminary

| Sample<br>Number | Irradiation<br>Temperature<br>(°C) | Fluence<br>(x1E+21) |
|------------------|------------------------------------|---------------------|
| 1                | Unirradiated                       | 0.00                |
| 2                | 200                                | 0.06                |
| 3                | 200                                | 0.10                |
| 4                | 300                                | 0.60                |
| 5                | 300                                | 1.40                |
| 7                | 600                                | 0.05                |
| 9                | 400                                | 0.09                |
| 10               | 400                                | 0.48                |
| 11               | 600                                | 1.44                |
| 12               | 400                                | 1.64                |
| 13               | 600                                | 2.32                |
| 14               | 800                                | 0.05                |
| 15               | 800                                | 0.05                |
| 16               | 800                                | 0.10                |
| 17               | 800                                | 0.10                |
| 18               | 800                                | 0.50                |
| 19               | 800                                | 7.70                |
| 20               | 800                                | 1.94                |
| 21               | 800                                | 4.30                |
| 22               | Unirradiated                       | 0.00                |
| 24               | 800                                | 0.05                |
| 25               | 800                                | 0.10                |
| 27               | 1010                               | 2.30                |
| 39               | 1508                               | 5.80                |





#### **Background: IR and P-content**

The P-doping level varied between 1.1x10<sup>15</sup> - 1.2x10<sup>19</sup> at/cm<sup>3</sup>





#### Background: IR, grain size & surface roughness

 IR characterization on polycrystalline 3C-SiC samples with grain sizes ranging from 1.8 to 7.5 μm.





#### IR and neutron irradiation: 0-700°C





#### IR and neutron irradiation: 800°C





#### IR and neutron irradiation: >1000°C





1200

#### IR and neutron irradiation: Temp & FWHM

260

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240 220 200 FWHM (cm-1) 180 Temp (> 1000°C) 160 Temp (800°C) 140 Temp (600-700°C) Temp (0-400°C) 120 100 200 <sup>600</sup> Temperature (°C) 400 800 1000 0

Investigate possibility of two temperature regimes namely:

- 0-400°C and
- 600-1000°C



# IR and neutron irradiation: Irradiation fluence & FWHM



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### **Conclusions & Next actions: Preliminary**

- The possible trend observed with increased irradiation temperature may be in fact due to surface roughness changes and not necessarily due to irradiation effects—needs to be evaluated.
- Preliminary results shows no specific/significant trend for the influence of irradiation fluence on the IR spectra for properties investigated for this preliminary study-----influence on peak wave number changes still needs to be examined.
- No prominent 2<sup>nd</sup> peak is observed for any of the samples investigated.
- Recommend that carrier concentration be determined using IR spectra and then experimentally verified using SIMS
- Future work to consider the measurement of absorbance & transmission spectra
- Complete interpretation of current results needs to be completed in conjunction with grain size, microstructure evaluation with critical value analysis for characterization technique for SiC in TRISO particles.





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