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Micro-Tensile Properties of Irradiated AGR-2 TRISO Fuel Pyrolytic Carbon and Silicon Carbide Coatings

December 2024

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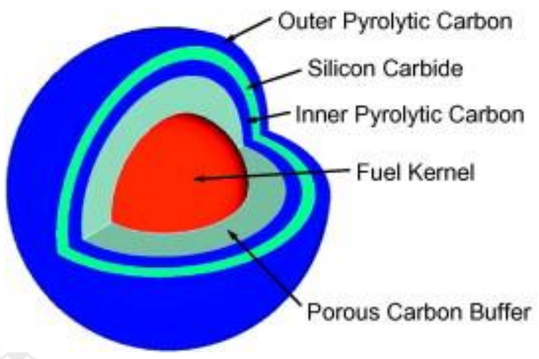
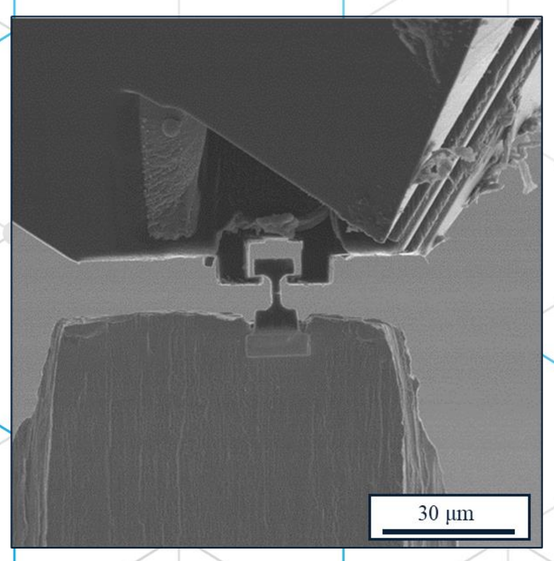
Introduction

- Mechanical and structural TRISO data are essential for failure modeling and licensing
- Mauseth (2023) developed micrometer-scale tensile strength testing for TRISO layers



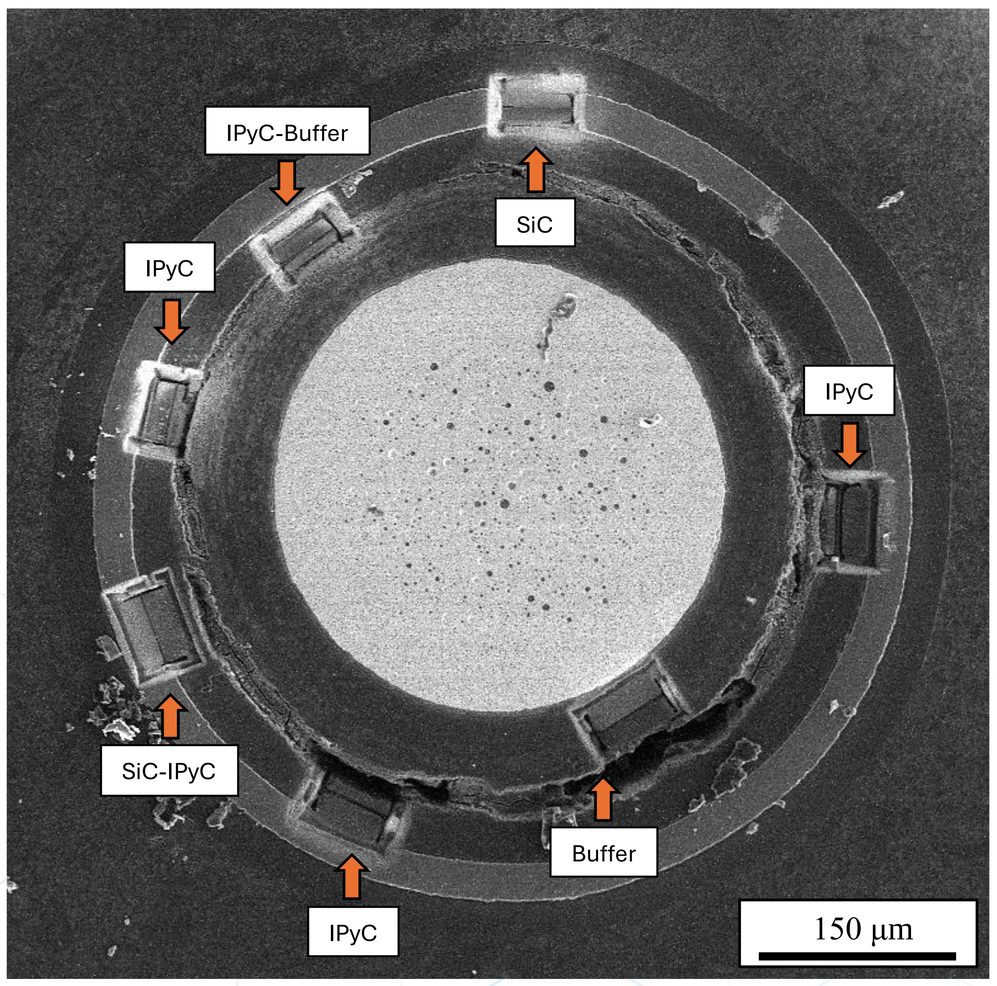
Methodology

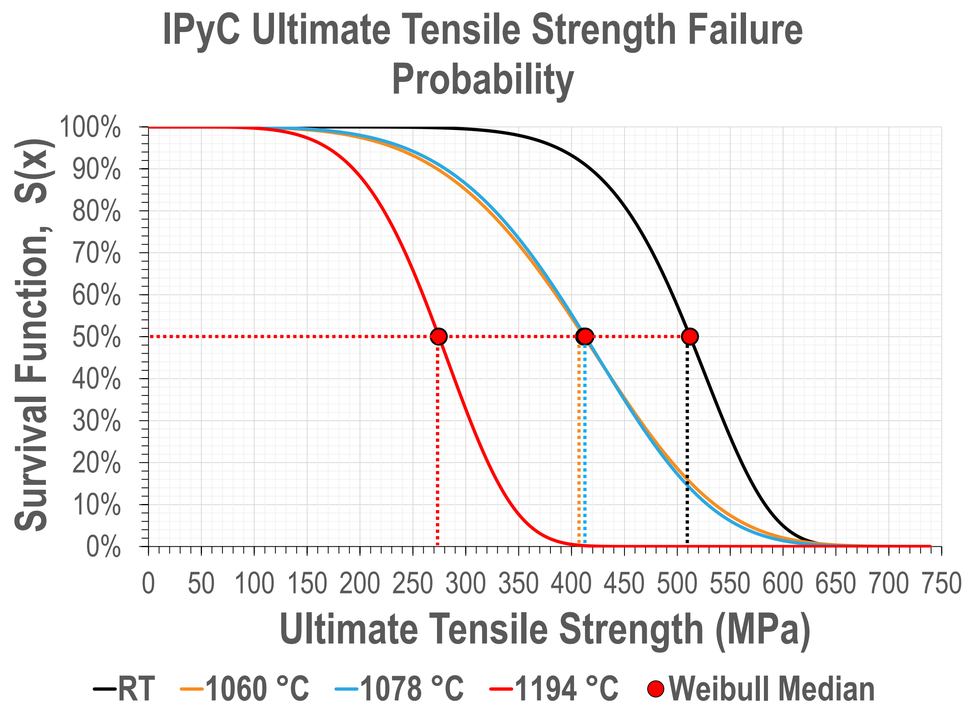
- Micro-tensile samples were fabricated using a gallium FEI Quanta 3D FIB and a Thermo G3 Plasma PFIB at IMCL
- A Bruker Hysitron PI 88 SEM PicoIndenter, retrofitted with a diamond gripper, was used for micro-tensile testing



Results

- Six AGR-2 UCO TRISO particles were tested across three different Time Average Volume Average (TAVA) temperatures, with the Buffer, IPyC-Buffer, and IPyC layers tested at each temperature
- Fractured Buffer, SiC-IPyC, and SiC layers were tested in the two samples with higher TAVA temperatures





Conclusion

- **Buffer/Fractured Buffer Layer:** Strength varied with TAVA due to porosity and microstructural changes from irradiation and temperature
- **IPyC and IPyC-Buffer Interlayer:** Strength of IPyC decreased with increased TAVA; buffer strength impacted IPyC-Buffer debonding
- **SiC and SiC-IPyC Interlayer:** SiC strength decreased with increased TAVA; SiC-IPyC interlayer showed lower strength than individual SiC and IPyC layers
- **Future Work:** Further testing is planned for FY2025 to clarify TRISO layer properties, including high-temperature, anisotropic, and size-effect studies, along with Pd effects on OPyC-SiC and SiC-IPyC layers

References

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[2] Mauseth, T., et al. (2023). Determining the tensile strength of fuel surrogate TRISO-coated particle buffer, IPyC, and buffer-IPyC interlayer regions. J. Nucl. Mater., 154540. https://doi.org/10.1016/J.JNUCMAT.2023.154540

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