

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

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Tanner Jason Mauseth, Fei Teng, Lu Cai, John D Stempien





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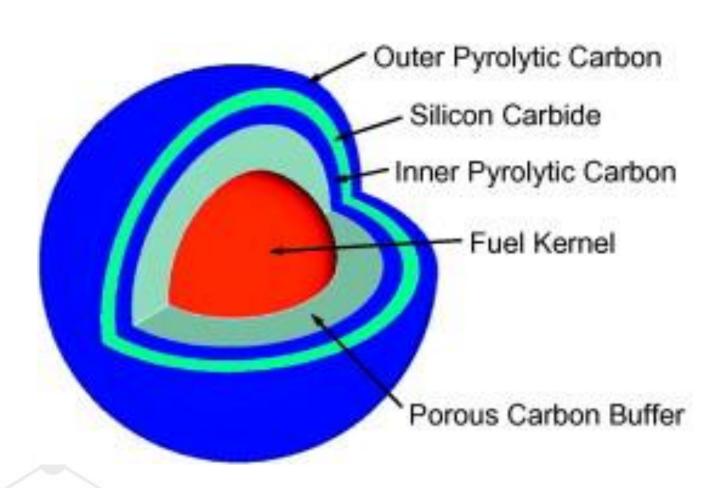
Idaho National Laboratory Idaho Falls, Idaho 83415

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Prepared for the U.S. Department of Energy Under DOE Idaho Operations Office Contract N/A Tanner Mauseth<sup>1</sup>, Fei Teng<sup>1</sup>, Lu Cai<sup>1</sup>, and John Stempien<sup>1</sup> <sup>1</sup>Idaho National Laboratory, Idaho Falls, ID, USA

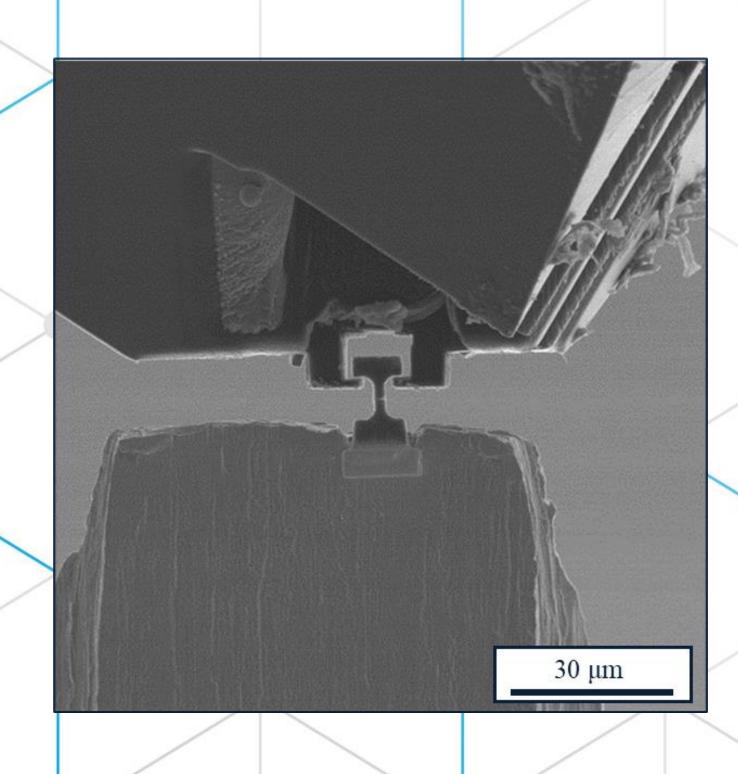
### Introduction

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



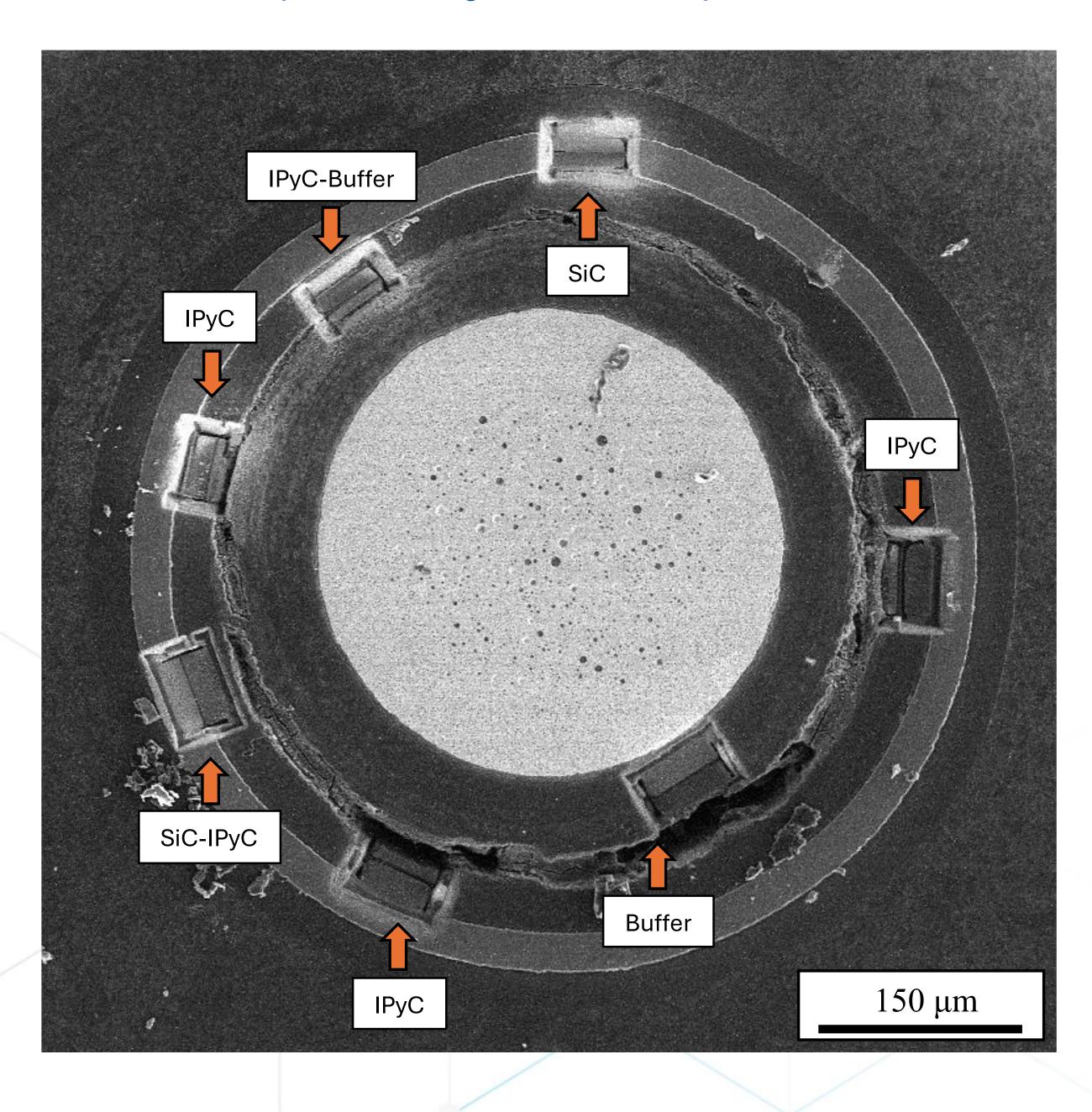
## Methodology

- 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

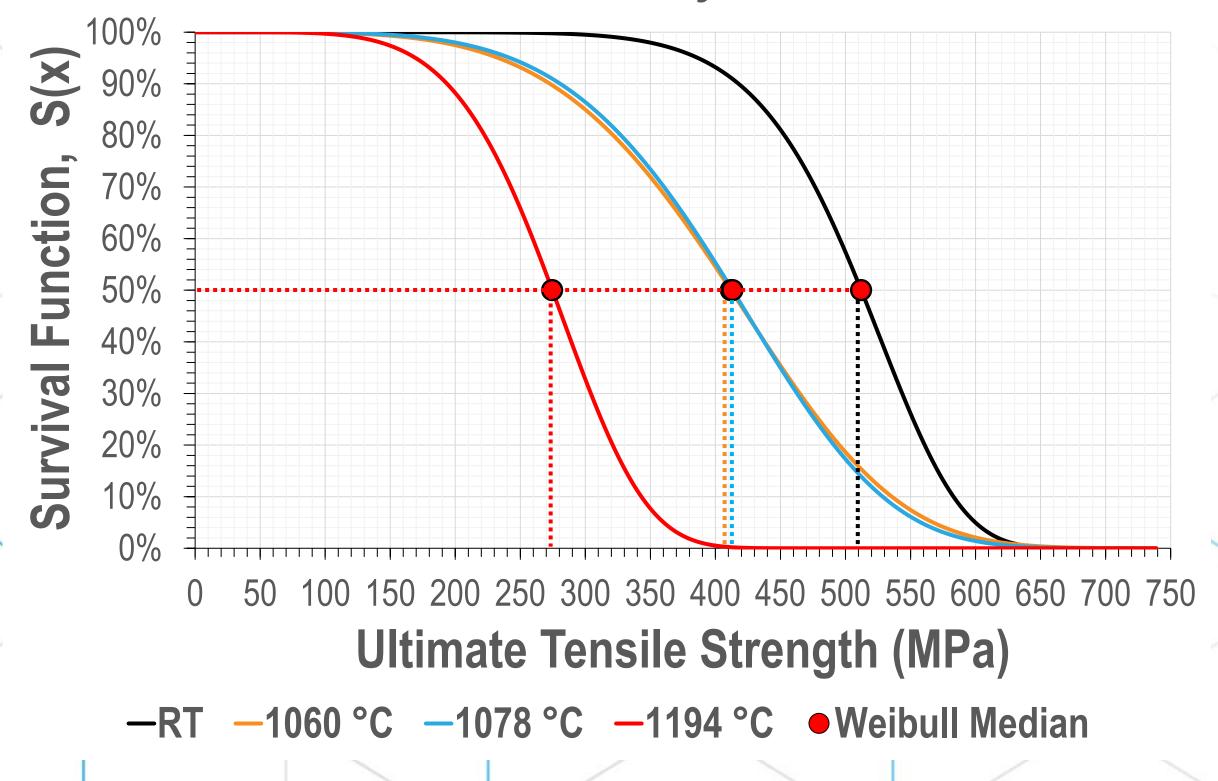
- Six AGR-2 UCO TRISO particles were tested across three different Time Average Volume Average (TAVA) temperatures, with the Buffer, IPyC-Buffer, and IPyC layers tested at each temperature
- Fractured Buffer, SiC-IPyC, and SiC layers were tested in the two samples with higher TAVA temperatures



### 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

### **IPyC Ultimate Tensile Strength Failure Probability**



#### References

[1] Hales, J. D., et al. (2013). Multidimensional multiphysics simulation of TRISO particle fuel. J. Nucl. Mater., 443(1-3), 531-543. https://doi.org/10.1016/j.jnucmat.2013.07.070

[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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### **Further Information**

Tanner Mauseth, Ph.D. (he/him) Nuclear Materials Research Engineer Characterization, Materials & Fuels Complex, Idaho National Laboratory Email: Tanner.Mauseth@inl.gov Phone: 208-533-9396 / 208-530-2953 Address: PO Box 1625, MS 6000, Idaho Falls, ID 83415

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