

ANNE A. CAMPBELL PH.D. (SHE/HER)

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R&D Staff – Nuclear Materials, Advanced Nuclear Materials Group, Materials Science & Technology Division, Oak Ridge National Laboratory

EDUCATION

Ph.D.

Nuclear Engineering and Radiological Sciences, University of Michigan, Ann Arbor, Michigan.
(Concentration in Radiation Effects in Materials)

Thesis Advisor: Professor Gary S. Was

Thesis Title: *The Mechanism of Proton Irradiation-Induced Creep in Ultra-Fine Grain Graphite*

Thesis Defended: November, 2013, Awarded May, 2014 GPA 4.0/4.0

M.S.E.

Nuclear Engineering and Radiological Sciences, University of Michigan, Ann Arbor, Michigan.
May 2009 GPA 4.0/4.0

B.S.E.

Nuclear Engineering, Purdue University, West Lafayette, Indiana December 2006,
GPA 3.59/4.0

CURRENT RESEARCH FOCUS/INTERESTS

Fundamental understanding of radiation effects in materials for current and next-generation nuclear systems

- Changes in bulk physical and mechanical properties of nuclear graphite and carbon composites, resulting from neutron irradiation at various temperatures and fluences (dimensional, strength, elastic properties, thermal conductivity, thermal expansion, electrical conductivity, stored energy)
 - Leading/led multiple graphite qualification campaigns – involved specimen size selection for irradiation, irradiation plan (temperature and fluence conditions), pre- and post-irradiation property measurements, data analytics/statistical analysis, reporting.
- Evolution of microstructure of graphite and carbon composites over multiple length scales due to neutron irradiation at various temperatures and fluences
 - Knowledge and application of currently used techniques
 - Implementation of techniques not previously used
- Use of neutron scattering at ORNL SNS and HFIR for studying irradiation-induced changes to nuclear materials
 - One of the first researchers to perform work at SNS on activated materials
 - Proposal planning and writing
 - Collaborated on a project at the SANS at HFIR
 - Inelastic neutron scattering at SNS to study phonon density of states changes
- Microstructure effects on diffusion of fission products in graphite and carbon composites
- Methods of reducing graphite waste from advanced reactors
- Effect of different matrix graphite recipes/compositions on various properties and how different recipes would be better tailored for different advanced reactor concepts
- Development of advanced materials for extreme environments
- Irradiation effects on the diffusion of fission products in SiC
- Effects of stored energy recovery on the dimensional response of SiC as accident tolerant fuel cladding during accident conditions

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- Understanding and analysis of SiC radiation damage recovery as a passive temperature measurement technique, using different types of post-irradiation annealing and property measurements
- Neutron irradiation-induced creep of ferritic/martensitic steels for fission and fusion applications – experimental planning, implementation, and post-irradiation examination for mechanistic understanding
- Neutron irradiation-induced creep of accident tolerant fuel materials – experimental planning, implementation, and post-irradiation examination for mechanistic understanding
- Fluidized bed deposition of TRISO fuel layers, how deposition conditions can be tailored to achieved desired microstructure features
- Alternative chemical vapor infiltration (CVI) methods for enhancing materials and fuels properties for advanced uses

COMPETENCIES

- Ability to discuss complex topics in a way that is understandable to a wide range of audiences
- Relay experimental results and scientific findings to an audience through written and oral communication
- Ability to coordinate and work with others on multi-faceted research programs, funded by both government agencies and private industry
- Designing experimental facilities to perform a series of complex measurement
- Write standard operating procedures that are suitable for training new researchers on the safe use and operation of technically complex equipment, while maintaining ORNL NQA-1 compliance
- Ability to rapidly learn about, and implement, novel experimental techniques
- Tenacity to approach a problem and continue working on it until a solution is found, and the ability to know when to ask others for guidance or assistance
- Self-motivated and able to remain on schedule when coordinating work on multiple programs with varied deadlines and meeting deadlines
- Enjoys collaborative environments and working with others to solve complex scientific problems
- Detail orientated, especially when dealing with analysis and discussion of large data sets
- Safety conscientious, with experience dealing with safety protocols when working with irradiated/activated materials

TECHNICAL SKILLS

- Microscopy (Optical, SEM, limited TEM, Raman)
- Microstructure analysis (XRD, nitrogen porosimetry, micro-tomography)
- Materials property testing (Young's modulus, thermal conductivity, coefficient of thermal expansion, strength, fracture toughness, density, electrical resistivity, stored energy)
- Statistical Analysis (R, Origin, GraphPad PRISM, WeibPar)

EDITORIAL ACTIVITIES

- 1) Associate Editor – *Journal of Nuclear Materials* (January 2023 – present)
- 2) Topical editor “Women in Nuclear Engineering Research” collection in *Frontiers in Nuclear Engineering* (2023)

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PROFESSIONAL SOCIETY ACTIVITIES

- TMS Structural Materials Division Council Member (2023-2026)
- TMS Structural Materials Division representative on the Content Development and Dissemination Committee (2023-2026)
- Technical Chair (elected position) for Materials in Nuclear Energy Systems (MiNES) 2023 (general chair for 2025)
- Lead organizer for “Composite Materials for Nuclear Applications - II” symposium for TMS-2023 annual meeting
- Assistant Technical Chair (elected position) for Materials in Nuclear Energy Systems (MiNES) 2021 (will become technical chair for 2023 and general chair for 2025)
- Lead organizer for “Composite Materials for Nuclear Applications” symposium for TMS-2021 annual meeting
- Co-organizer – International Nuclear Graphite Specialist Meeting 2020 (now 2021), virtual
- Organizing committee member – Materials in Nuclear Energy Systems (MiNES) 2019
- Co-organizer “Materials and Fuels for the Current and Advanced Nuclear Reactors VII” symposium, TMS-2018 annual meeting
- Co-organizer – International Nuclear Graphite Specialist Meeting 2017, Baltimore MD
- Active member TMS Nuclear Materials Committee
- ANS Materials Science and Technology Executive Committee member (2016-2019)

CODES AND STANDARDS ACTIVITIES

- American Society for Testing Materials (ASTM) International
 - Voting member of Subcommittee D02.F0 Manufactured Carbon and Graphite Products
 - Non-voting member of Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants
 - Non-voting member of Committee C28 on Advanced Ceramics
 - Non-voting member of Subcommittee C28.01 Mechanical Properties and Performance
 - Non-voting member of Subcommittee C28.03 Physical Properties and Non-Destructive Evaluation
- American Society of Mechanical Engineers (ASME)
 - Member Working Group on Nonmetallic Design and Materials (SG HTR)(BPV III)
 - Member of irradiation effects in graphite task group (nonmetallic working group)
 - Member of composites task group (nonmetallic working group)
 - Member of design task group (nonmetallic working group)
 - Member Task Group on Non-metallic Component Degradation and Failure Monitoring (SG-RIM)(BPV XI)
 - Member Working Group on General Requirements for Graphite and Ceramic Composite Core Components And Assemblies (SG GR)(BPV III)
 - Member Special Working Group on High Temperature Reactor Stakeholders (SG HTR)(BPV III)

INVITED JOURNAL PUBLICATIONS

- 1) **A.A. Campbell**, “Perspective on “Code Qualifying” New Graphite Grades for Use in Advanced Nuclear Reactors”, *Frontiers of Nuclear Engineering*, Special Issue Rising Stars in Nuclear Materials 2022, 1 (2022) 1045607. <https://doi.org/10.3389/fnuen.2022.1045607>

JOURNAL PUBLICATIONS

- 2) **A.A. Campbell**, J.W. Geringer, A.M. Schrell, S. Baylis, T. Lucas, P.J. Pappano, M. van Staden, “Development of a Graphite Irradiation Qualification Plan for the XE-100 Reactor”, *Proceedings of the Pressure Vessels & Piping Conference*. Atlanta, Georgia, USA. July 16–21, 2023. PVP2023-106610.
- 3) M. Baig, J. Owusu-Danquah, **A.A. Campbell**, S.F. Duffy, “Review: Inelastic Constitutive Modeling: Polycrystalline Materials”, *Materials* 16 (2023) 3564.
- 4) **A.A. Campbell**, M.A. Snead, Y. Katoh, “Understanding the effect of Specimen Size on the Properties of Fine-Grain Isotropic Nuclear Graphite for Irradiation Studies: Physical, Electrical, Thermal Properties”, *Journal of Nuclear Materials*, 576 (2023) 154269
- 5) **A.A. Campbell**, A.A. Wereszczak, M.A. Snead, Y. Katoh, “Understanding the effect of Specimen Size on the Properties of Fine-Grain Isotropic Nuclear Graphite for Irradiation Studies”, *Journal of Nuclear Materials*, 576 (2023) 154263.
- 6) J.D. Arregui-Mena, R.N. Worth, W. Bodel, B. März, W. Li, A. Selby, **A.A. Campbell**, C. Contescu, P.D. Edmondson, N. Gallego, “SEM and TEM data of nuclear graphite and glassy carbon microstructures”, *Data in Brief* 46 (2023) 108808.
- 7) **A. A. Campbell**, A. A. Wereszczak, J. W. Geringer, and Y. Katoh, “Equibiaxial Flexure Strength of a Superfine-Grained Nuclear Graphite,” in *Graphite Testing for Nuclear Applications: The Validity and Extension of Test Methods for Material Exposed to Operating Reactor Environments*, ed. A. Tzelepi and M. Metcalfe (West Conshohocken, PA: ASTM International, 2022), 18–33.
- 8) T.J. Gerczak, **A.A. Campbell**, G.W. Helmreich, G.E. Jellison Jr., J.D. Hunn, “Texture Analysis of AGR Program Matrix Materials”, *Nuclear Engineering and Design*, 398 (2022) 111965.
- 9) J.D. Arregui-Mena, R.N. Worth, W. Bodel, B. März, W. Li, **A.A. Campbell**, E. Cakmak, N. Gallego, C. Contescu, P.D. Edmondson, “Multiscale characterization and comparison of historical and modern nuclear graphite grades”, *Materials Characterization*, 190 (2022) 112047.
- 10) I. Al-Qasir, Y. Cheng, J.Y.Y. Lin, **A.A. Campbell**, G. Sala, K.Ramic, F.F. Islam, A. Qteish, B. Marsden, D.L. Abernathy, M.B. Stone, “Neutron thermalization in nuclear graphite: A modern story of a classic moderator”, *Annals of Nuclear Energy*, 161 (2021) 108437.
- 11) K.I. Montoya , C.J. Moczygemba , B.A. Brigham , T.L. Spano , **A.A. Campbell** , T.J. Gerczak , E.S. Sooby, “Determination of preferential binder oxidation in HTGR matrix material subjected to high temperature steam”, *Journal of Nuclear Materials*, 544 (2021) 152674.
- 12) Arregui-Mena, J.D., L. Margetts, D.V. Griffiths, R.N. Worth, C. Contescu, **A. Campbell**, P.M. Mummery, N. Gallego, and P.D. Edmondson, "Recent advances on microstructural characterization and modeling of nuclear graphite", *Transactions of the American Nuclear Society*, Vol. 124, June 14-16, 2021, Virtual, p 308-310.
- 13) H. Wang, T. Koyanagi, J.W. Geringer, **A.A. Campbell**, Y. Katoh, “Determination of Neutron Irradiation Temperatures of SiC Using Electrical Resistivity Method”, *Journal of Nuclear Materials*, 540 (2020) 152370.
- 14) Gerczak, T.J., **A. Campbell**, G. Helmreich, G.E. Jellison Jr, and J.D. Hunn, "Texture analysis of AGR program matrix materials", *Proceedings of the 2021 International Topical Meeting on High Temperature Reactor Technology (HTR2021)*, Yogyakarta, Indonesia (Virtual), 2021 paper HTR 2021-138.
- 15) I. Al-Qasir, **A.A. Campbell**, G. Sala, J.Y.Y. Lin, Y. Cheng, F.F. Islam, D.L. Abernathy, M.B.

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- Stone, “Vacancy-Driven Variation in the Phonon Density of States of Fast Neutron Irradiated Nuclear Graphite”, *Carbon*, 168 (2020) 42.
- 16) Chen, X, Clowers, LA, Graening, T, Bhattacharya, A, **Campbell, AA**, Robertson, J, Geringer, JW, Sokolov, MA, Katoh, Y, & Rieth, M. "Post-Irradiation Evaluation of Eurofer97 Fracture Toughness Using Miniature Multinotch Bend Bar Specimens." *Proceedings of the . Volume 1: Codes and Standards*. Virtual, Online. August 3, 2020. V001T01A059. ASME.
 - 17) F. Islam, J.Y.Y. Lin, R. Archibald, D. Abernathy, I. Al-Qasir, **A.A. Campbell**, M. Stone, G.E. Granroth, “Super-resolution energy spectra from neutron direct-geometry spectrometers”, *Review of Scientific Instruments*, 90 (2019) 105109-1
 - 18) P.L. Mulligan, N.O. Cetiner, R. Gallagher, J.W. Geringer, **A.A. Campbell**, M. van Staden, “Finite Element Based Surrogate Modeling and Irradiation Capsule Optimization for Large-Scale Neutron Irradiation Campaigns”, *Transactions of the American Nuclear Society*, 120 (2019) 303-306.
 - 19) C.I. Contescu, J.D. Arregui-Mena, **A.A. Campbell**, P.D. Edmondson, N.C. Gallego, K. Takizawa, Y. Katoh, “Development of mesopores in superfine grain graphite neutron irradiated at high fluence”, *Carbon* 141 (2019) 663.
 - 20) J.D. Arregui-Mena, C.I. Contescu, **A.A. Campbell**, P.D. Edmondson, N.C. Gallego, Q.B. Smith, K. Takizawa, Y. Katoh, “Nitrogen adsorption data, FIB-SEM tomography and TEM micrographs of neutron-irradiated superfine grain graphite”, *Data in Brief*, 21 (2018) 2643.
 - 21) T.J. Gerczak, J.D. Hunn, B.C. Jolly, A.T. Schumacher, X. Hu, **A.A. Campbell**, J.A. Dyer, “Development of Planar PyC/SiC Diffusion Couples to Investigate Irradiation Effects and Microstructure Variation on Fission Product Diffusion”, *Proceedings of the 2018 International Topical Meeting on High Temperature Reactor Technology (HTR2018)*, Warsaw, Poland 2018, paper #47.
 - 22) J.D. Arregui-Mena, P.D. Edmondson, **A.A. Campbell**, Y. Katoh, “Site specific, high-resolution characterisation of porosity in graphite using FIB-SEM tomography”, *Journal of Nuclear Materials* 511 (2018) 164.
 - 23) **A.A. Campbell**, “Historical experiment to measure irradiation-induced creep of Graphite”, *Carbon* 139 (2018) 279-288.
 - 24) Contescu, C., **Campbell, A.**, Burchell, T., Gallego, N., Qualls, A.L., “Graphite materials in salt-cooled high temperature reactors: Known issues from past experience and proposed path forward for their mitigation”, *Proceedings of the 2018 International Congress on Advances in Nuclear Power Plants, ICAPP 2018*, 2018, pp. 1168–1175.
 - 25) X. Zhou, **A.A. Campbell**, Y. Katoh, Z. Lu, J. Zhang, C.I. Contescu, and B. Liu, "Property evaluation and microstructure characterization of the A3-3 matrix graphite", *Proceedings of the 2016 International Topical Meeting on High Temperature Reactor Technology (HTR2016)*, Las Vegas, NV, 2016, 772-775.
 - 26) **A.A. Campbell**, Y. Katoh, M.A. Snead, K. Takizawa, Property changes of G347A graphite due to neutron irradiation, *Carbon* 109 (2016). 860-873.
 - 27) **A.A. Campbell**, K. Takizawa, E. Cakmak, Y. Katoh, “Neutron Irradiation Effects on the Graphitic Structure of a Fine-Grain Graphite”, *Transactions of the American Nuclear Society and Embedded Topical Meeting Nuclear Fuels and Structural Materials for the Next Generation Nuclear Reactors (NFSM)*, Vol. 114, June 12-16, 2016, New Orleans, LA, p 1119-1120.
 - 28) **A.A. Campbell**, W.D. Porter, Y. Katoh, L.L. Snead, “Method for Analyzing Passive Silicon Carbide Thermometry with a Continuous Dilatometer to Determine Irradiation Temperature”, *Nuclear Instruments and Methods in Physics Research B*, 370 (2016), 49-58.
 - 29) Numerous authors, “LAMDA: A facility for advanced characterization of irradiated materials at Oak Ridge National Laboratory”, *Transactions of the American Nuclear Society*, Vol. 113, Washington, D.C., November 8–12, 2015, p581-582.
 - 30) **A.A. Campbell**, and G.S. Was, “Proton Irradiation-Induced Creep of Ultra-Fine Grain Graphite”, *Carbon*, 77 (2014), 993-1010.

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- 31) **A.A. Campbell**, K.B. Campbell, and G.S. Was, “Anisotropy Analysis of Ultra-Fine Grain Graphite and Pyrolytic Carbon”, *Carbon*, 60 (2013) 410.
- 32) **A.A. Campbell** and G.S. Was, “In-Situ Proton Irradiation-Induced Creep at Very High Temperature”, *Journal of Nuclear Materials*, 433, (2013), 86-94.
- 33) **A.A. Campbell**, K.B. Campbell, and G.S. Was, “A Methodology for Quantitative Determination of Anisotropy of Pyrolytic Carbon”, *Transactions of the American Nuclear Society and Embedded Topical Meeting Nuclear Fuels and Structural Materials for the Next Generation Nuclear Reactors (NFSM)*, Vol. 102, June 13-17, 2010, San Diego, CA, p 843-844.

BOOK CHAPTERS

1. **A.A. Campbell**, T.D. Burchell, “Radiation Effects in Graphite”, *Comprehensive Nuclear Materials*, 2nd edition, August 2020.
2. F. Onimus, T. Jourdan, C. Xu, J. Garnier, **A.A. Campbell**, M. Griffiths, “Irradiation creep in materials”, *Comprehensive Nuclear Materials*, 2nd edition, August 2020.

INVITED TALKS/SEMINARS

- 1) **A.A. Campbell**, E. Cakmak, “Utilizing X-Ray Diffraction and Williamson-Hall Analysis to Quantify Microstructural Changes in Irradiated Nuclear Graphite”, The Nuclear Materials Conference (NuMAT-2022), Ghent, Belgium, October 2022.
- 2) I. Al-Qasir, **A.A. Campbell (presenter)**, M.B. Stone, G. Sala, J.Y.Y. Lin, F.F. Islam, G. Granroth, P.D. Edmondson, A. Qteish, D.L. Abernathy, “Measurement of the Phonon Density of States of Fast Neutron Irradiated β -SiC”, The Nuclear Materials Conference (NuMAT-2022), Ghent, Belgium, October 2022.
- 3) **A.A. Campbell**, “Nuclear Graphite for Advanced Reactors”, Invited lecture at the 2022 Modeling, Experimental, and Validation (MeV) School, Oak Ridge, TN, July 2022.
- 4) **A.A. Campbell**, “Challenges with ASME “Code Qualifying” Graphite Irradiation Effects in Test Reactors”, Invited presentation at the U.S. NRC Advanced Non-Light Water Reactors – Materials and Component Integrity Workshop, Rockville, MD December 2019.
- 5) **A.A. Campbell**, “Understanding Graphite Behavior in Nuclear Reactor Environments for Lifetime Predictions”, Invited presentation at the U.S. NRC Advanced Non-Light Water Reactors – Materials and Component Integrity Workshop, Rockville, MD December 2019.
- 6) **A.A. Campbell**, “Nuclear Graphite for Advanced Reactors”, Invited lecture at the 2019 Modeling, Experimental, and Validation (MeV) School, Oak Ridge, TN, July 2019.
- 7) **A.A. Campbell**, J.D. Arregui-Mena, Y. Katoh, C.I. Contescu, “Mechanical and Thermal Behavior of Graphite in Nuclear Reactor Applications”, invited presentation at TMS 2019 Annual Meeting & Exhibition, San Antonio, TX, March 2019.
- 8) **A.A. Campbell**, “Understanding Changes to Graphite Properties in Nuclear Reactor Environments”, Invited presentation at 2017 MRS Fall Meeting and Exhibit, Boston, MA, November 2017.

REVIEWER ACTIVITIES

- 1) Editorial Board Member – “Materials Today Communications”
- 2) Editorial Board Member/Review Editor – *Frontiers in Nuclear Engineering*
- 3) Journals: *AIP Advances*, *ASTM*, *Carbon*, *Carbon Trends*, *Diamond and Related Materials*, *Journal of Applied Physics*, *Journal of Nuclear Materials*, *Micron*, *Nuclear Science and Technology*, *Nuclear Technology*, *Radiation Physics and Chemistry*, *Nuclear Instruments and Methods in Physics Research Section B (NIMB): Beam Interactions with Materials and Atoms*.
- 4) Book Chapters: *Comprehensive Nuclear Materials* 2nd Ed
- 5) Proposals: DOE-BES, DOE-FES, DOE-NE, DOE NSUF-CINR, DOE NSUF-RTE

ORNL REPORTS

- 1) A.M. Schrell, J. Chappell, A.A. Campbell, J.W. Geringer, “Design and Thermal Analysis for Multi-use Graphite Capsules in the High Flux Isotope Reactor”, ORNL/TM-2023/3111.
- 2) M. Davenport, W.E. Windes, **A.A. Campbell**, “Options, Initial Design Requirements, Estimated Costs, Reactor Commitments, and Potential Uses of a Graphite Leadout Type Experiment Supporting Various Commercial HTR Vendors”, INL/RPT-23-74712 (2023).
- 3) A.M. Schrell, P.L. Mulligan, J. Chappell, **A.A. Campbell**, J.W. Geringer, “Design and Thermal Analysis for Irradiation of Low Temperature Low Dose Graphite in the High Flux Isotope Reactor”, ORNL/TM-2023/3082.
- 4) A.L. Till, A.M. Schrell, J.W. Geringer, **A.A. Campbell**, “X-energy Irradiation Status Update 2023”, ORNL/LTR-2023/3078.
- 5) P.L. Mulligan, **A.A. Campbell**, C.M. Parish, A.M. Schrell, B. La Riviere, “Qualification of Commercially Available Silicon Carbide for Passive Thermometry in Reactor Experiments–FY23 Status Report”, ORNL/TM-2023/3059.
- 6) **A.A. Campbell**, E. Cakmak, B. Henry, K. Johnson, D. Muzquiz, Y. Osetskiy, E. Paxton, S. Raiman, D. Sulejmanovic, E. Zarkadoula, D. Holcomb, “Be₂C synthesis, properties, and ion-beam irradiation damage characterization”, ORNL/TM-2023/3011.
- 7) **A.A. Campbell**, W.E. Windes, S.D. Johns, “Summary of Vendor Irradiation Capsule Workshop Hosted at Oak Ridge National Laboratory, October 3-4, 2022”, ORNL/TM-2023/2945.
- 8) **A.A. Campbell**, “Fundamental Graphite Irradiation Behavior Research at ORNL for FY23”, ORNL/LTR-2023/2881
- 9) **A.A. Campbell**, D. Muzquiz, S. Raiman, D.E. Holcomb, “Coupon synthesis status report”, ORNL/LTR-2023/2735.
- 10) T.D. Burchell, D. Erdman III, R. Lowden, J. Hunter, C. Hannel, **A.A. Campbell**, “The Fracture Toughness of Nuclear Graphite Grades”, ORNL/TM-2016/678 Rev.1
- 11) J.W. Geringer, **A.A. Campbell**, “Oak Ridge National Laboratory Graphite Pre-Irradiation Test Specification for X Energy, LLC.”, ORNL/TM-2022/2403.
- 12) C. On, A. Bhattacharya, X. Chen, J.W. Geringer, J. Reed, **A.A. Campbell**, Y. Katoh, “Annual DOE-QST Collaborative Research Report”, ORNL/SPR-2022/2424.
- 13) **A.A. Campbell**, J.W. Geringer, “X Energy, LLC. NBG-18 Machining Package for MWI, Inc.”, ORNL/TM-2022/2357.
- 14) **A.A. Campbell**, C. On, J. Reed, J.W. Geringer, “Disassembly and Analysis of Silicon Carbide Temperature Monitors from AECL-09 and AECL-10 (Campaign 8)”, ORNL/TM-2021/2360.
- 15) J.W. Geringer, **A.A. Campbell**, A. Schrell, “Memorandum on Irradiation Plan for X Energy Low Temperature Capsules”, ORNL/LTR-2021/2309.
- 16) J.W. Geringer, **A.A. Campbell**, A. Schrell, C. Contescu, C. On, M. Vance, “Progress on Graphite Irradiation Program thru September 2021”, ORNL/TM-2021/2167.
- 17) **A.A. Campbell**, J.D. Arregui-Mena, J.W. Geringer, Y. Katoh, “Report on the Results from the Screening Phase of the Sinosteel Irradiation Campaign - Sinosteel Advanced Materials (Zhejiang) Co., Ltd.”, ORNL/TM-2017/427.
- 18) **A.A. Campbell**, J.D. Arregui-Mena, M. Snead, J.W. Geringer, Y. Katoh, “Report on the Results from the PIE-1S Sinosteel Irradiation Campaign - Sinosteel Advanced Materials (Zhejiang) Co., Ltd.”, ORNL/TM-2016/582.
- 19) X. Chen, K.G. Field, **A.A. Campbell**, J. Werden, Y. Yamamoto, C. Masey, K. Linton, A. Nelson, “Fracture Toughness Characterization of Generation II FeCrAl Alloys after ~18 dpa Irradiation”, ORNL/TM-2021/2064.

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- 20) **A.A. Campbell**, J.W. Geringer, “X Energy, LLC. NBG-18 Machining Package for MWI, Inc.”, ORNL/TM-2021/2018.
- 21) **A.A. Campbell**, J.W. Geringer, “X Energy, LLC. PCEA Machining Package for MWI, Inc.”, ORNL/TM-2021/2017.
- 22) J. Reed, X. Chen, **A.A. Campbell**, A. Bhattacharya, J.W. Geringer, Y. Katoh, “Annual DOE-QST Collaborative Research Report” ORNL/SPR-2021/1901.
- 23) **A.A. Campbell**, J.W. Geringer, “Determining Low Temperature Irradiated Properties of PCEA and NBG-18 Graphite Grades”, ORNL/TM-2021/1937.
- 24) **A.A. Campbell**, J.W. Geringer “Determining Irradiated Properties of PCEA and NBG-18 Graphite Grades”, ORNL/TM-2021/1931.
- 25) J.W. Geringer, **A.A. Campbell**, P. Mulligan, C. On, A. Schrell, “Progress Report of the Oak Ridge National Laboratory NBG-18 and PCEA Qualification Level Irradiation Program: Period Ending September 2022”, ORNL/TM-2020/1740.
- 26) J.W. Geringer, **A.A. Campbell**, “AGM PCEA Billet Selection for Size Effect Study and Irradiation Program”, ORNL/LTR-2020/1643.
- 27) **A.A. Campbell**, J.W. Geringer, “NBG-18 Size Effect Study for X-energy, LLC.”, ORNL/TM-2020/1573.
- 28) **A.A. Campbell**, J.W. Geringer, “PCEA Size Effect Study for X-energy, LLC.”, ORNL/TM-2020/1563.
- 29) J. Reed, J.W. Geringer, J. Robertson, **A.A. Campbell**, C. On, X. Chen, Y. Katoh, “Annual DOE-QST Collaborative Research Report for Japanese Fiscal Year 2019 / US Fiscal Year 2020”, ORNL/SPR-2020/1489.
- 30) T.J. Gerczak, R. Seibert, A. Schumacher, G. Helmreich, **A.A. Campbell**, J.D. Hunn, “FY19Q4 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/SPR-2019/1381.
- 31) **A.A. Campbell**, C.I. Contescu, E. Cakmak, N.C. Gallego, T.D. Burchell, “Effects of High-Temperature Irradiation on the Microstructure of Nuclear Graphite”, ORNL/TM-2019/1309.
- 32) J.W. Geringer, **A.A. Campbell**, J. Robertson, “Analysis of SiC Temperature Monitors from AECL Capsule Series (Campaign 6)”, ORNL/TM-2019/1261.
- 33) T.J. Gerczak, J.D. Hunn, R. Seibert, **A.A. Campbell**, “FY19Q3 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/SPR-2019, 1241.
- 34) **A.A. Campbell**, J.W. Geringer, P. Mulligan “Progress Report of the Oak Ridge National Laboratory NBG-18 Qualification Level Irradiation Program: Period Ending June 2019”, ORNL/TM-2019/1212.
- 35) T.J. Gerczak, **A.A. Campbell**, X. Hu, J.D. Hunn, R. Seibert, “FY19Q2 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/SPR-2019/1167.
- 36) T.J. Gerczak, **A.A. Campbell**, X. Hu, J.D. Hunn, R. Seibert, A. Schumacher, B. Jolly, “FY19Q1 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/SPR-2019/1073.
- 37) **A.A. Campbell**, J.W. Geringer, “SGL Carbon NBG-18 Billet Selection for Size Effect Study and Irradiation Program”, ORNL/LTR-2018/1038.
- 38) T.J. Gerczak, **A.A. Campbell**, X. Hu, J.D. Hunn, R. Seibert, “FY18Q4 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/SPR-2018/1046.
- 39) **A.A. Campbell**, Y. Katoh, “Summary Report on Effects of Irradiation on Material IG-110 – Prepared for Toyo Tanso Co., Ltd.”, ORNL/TM-2018/1040.
- 40) **A.A. Campbell**, J.W. Geringer, “SGL Carbon NBG-18 Size Effect Study for X-energy – Revision 4”, ORNL/TM-2018/1024.
- 41) T.J. Gerczak, **A.A. Campbell**, X. Hu, J.D. Hunn, B. Jolly, R. Seibert, A. Schumacher, “

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- 42) Preparation of Diffusion Couples for Irradiation and High Temperature Testing of Representative TRISO PyC/SiC”, ORNL/TM-2018/1012.
- 43) **A.A. Campbell**, J.W. Geringer, B. Eckhart, K. Leonard, “Analysis of Silicon Carbide Temperature Monitors from AECL-11 and AECL-12 Capsules”, ORNL/TM-2018/960.
- 44) T.J. Gerczak, **A.A. Campbell**, X. Hu, J.D. Hunn, B. Jolly, A. Schumacher, R. Seibert, “FY18Q3 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/TM-2018/918.
- 45) J.W. Geringer, **A.A. Campbell**, P. Mulligan, N. Cetiner, T.D. Burchell, “Progress planning for irradiation, designing irradiation capsule, and measuring pre-irradiation properties of specimens made from NBG-18 graphite”, ORNL/LTR-2018/512
- 46) **A.A. Campbell**, Y. Katoh, “Cumulative Results of Irradiation Induced Creep of Material IG-110 - Prepared for Toyo Tanso Co., Ltd.”, ORNL/LTR-2018/511.
- 47) T.J. Gerczak, **A.A. Campbell**, J.D. Hunn, B. Jolly, A. Schumacher, “FY18Q2 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/TM-2018/835.
- 48) T.J. Gerczak, **A.A. Campbell**, J.D. Hunn, A. Schumacher, B. Jolly, “FY18Q1 Quarterly Report: Radiation Enhanced Diffusion of Ag, Ag-Pd, Eu, and Sr in Neutron Irradiated PyC/SiC Diffusion Couples”, ORNL/TM-2018/766.
- 49) **A.A. Campbell**, A.P. Selby, Y. Katoh, “Report on Effects of Irradiation on Material ETU-10 - Prepared for Ividen Co., Ltd”, ORNL/TM-2017/737.
- 50) **A.A. Campbell**, Y. Katoh, “Report on Effects of Irradiation on Material IG-110 - Prepared for Toyo Tanso Co., Ltd.”, ORNL/TM-2017/705.
- 51) T.J. Gerczak, **A.A. Campbell**, J.D. Hunn, B. Jolly, A. Schumacher, “Progress on Fabrication of Planar Diffusion Couples with Representative TRISO PyC/SiC Microstructure”, ORNL/TM-2017/704.
- 52) **A.A. Campbell**, J. McDuffee, R. Howard, “Discussion of Two-Temperature Zones for Sinosteel Creep Experiments”, ORNL/LTR-2017/357
- 53) **A.A. Campbell**, M. Snead, Y. Katoh, “Graphite Pre-Irradiation Specimen Size Validation and Testing Program NSCC-NCK Group Results”, ORNL/TM-2017/326
- 54) R. Stoller, R. Howard, **A.A. Campbell**, K. Leonard, “Oak Ridge National Laboratory Analysis of Silicon Carbide Temperature Monitors from AECL Irradiations in HFIR”, ORNL/TM-2017/189
- 55) **A.A. Campbell**, M. Snead, Y. Katoh, “Graphite Pre-Irradiation Specimen Size Validation (PSSV) Test Guide – Sinosteel Advanced Materials (Zhejiang) Co., Ltd.”, ORNL/TM-2016/719.
- 56) **A.A. Campbell**, M. Snead, “Graphite Pre-Irradiation Test Specification -Sinosteel Advanced Materials (Zhejiang) Co., Ltd.”, ORNL/TM-2016/264
- 57) **A.A. Campbell**, Y. Katoh, and M.A. Snead, “Final Report on Effects of Irradiation on Material G347A - Prepared for Tokai Carbon Co., Ltd.”, ORNL/TM-2015/665.
- 58) T.M. Rosseel, **A.A. Campbell**, D.E. Erdman, M. N. Gussev, Y. Le Pape, and C. M. Silva, “Report on the Post-irradiation Examination of Irradiated Mineral Analogues of Concrete Aggregate Specimens”, ORNL/LTR-2015/453
- 59) **A.A. Campbell**, Y. Katoh, M. Snead, “Determination of Specimen Temperature from Post-Irradiation Analysis of SiC Temperature Monitors” ORNL/LTR-2015/183.
- 60) **A.A. Campbell**, “Validation of the IMCE RFDA System for Dynamic Elastic Moduli Measurements”, ORNL/TM-2015/15.

EQUIPMENT OPERATING GUIDELINES

- 1) **A.A. Campbell**, “Measuring Dynamic Young’s Modulus and Shear Modulus via Sonic Velocity, ORNL Standard Operating Guideline.
- 2) **A.A. Campbell** and B.D. Eckhart, “Measuring Dynamic Young’s Modulus and Shear Modulus via Impulse Excitation, ORNL Standard Operating Guideline.

ANNE A. CAMPBELL PH.D. (SHE/HER)

PREVIOUS RESEARCH EXPERIENCE

Post-Doctoral Research

- Changes in physical and mechanical properties of nuclear graphite, resulting from neutron irradiation at various temperatures and fluences
 - Measurement of physical, thermal, and mechanical properties, and microstructural changes that occur in neutron-irradiated graphite
- Systematic analysis of passive SiC thermometry to determine irradiation temperature of non-instrumented neutron irradiation capsules.
- Microstructure analysis of graphite to understand the microstructure on multiple scales.
 - Knowledge and application of currently used techniques
 - Implementation of techniques not previously used
- Neutron irradiation effects on MAX phase materials.

Mentor: Yutai Katoh

Ph.D. Research

- Proton irradiation effects in graphite, including changes in dimensions, mechanical properties, crystal structure, and anisotropy during unrestrained irradiation, and changes in dimensions, mechanical properties, crystal structure, and anisotropy during stressed irradiation.
- Design and validation of a high temperature proton irradiation stage for performing proton irradiation-induced creep experiments on for graphite and other materials.
- Irradiation effects in pyrolytic carbon for TRISO fuel

Advisor: Prof. Gary S. Was

Oak Ridge National Laboratory – HERE Summer Internship

- Develop a method CVD (fluidized bed method) for producing pyrolytic carbon strip samples that can be used for irradiation-induced creep experiments. Operated fluidized bed in 4515.

Nuclear Materials Science and Technology Group

B.S. Research

- Modeling of Atucha II reactor fuel assemblies in MCNP5 and DRAGON
 - School of Nuclear Engineering, Purdue University, Supervisor: Prof. T. Downar
- Slow neutron modeling research in MCNP5 for use in boron neutron capture therapy
 - School of Nuclear Engineering, Purdue University, Supervisor: Prof. T. Jevremovic

EMPLOYMENT

UT-Battelle – Oak Ridge, Tennessee

06/2016 – Present

Staff Scientist at Oak Ridge National Laboratory in Advanced Nuclear Materials Group, Materials Science & Technology Division (08/2023 – present)

Research Associate at Oak Ridge National Laboratory in Nuclear Energy Materials Microanalysis Group, Materials Science & Technology Division (06/2016 – 07/2023)

Oak Ridge Associated Universities – Oak Ridge, Tennessee

03/2014 – 06/2016

Post-Doctoral Research Associate at Oak Ridge National Laboratory in Fusion Materials and Nuclear Structures group.

Mentor: Yutai Katoh

University of Michigan – Ann Arbor, Michigan

01/2007 – 02/2014

Nuclear Engineering and Radiological Sciences Graduate Student

Ph.D. advisor: Gary S. Was

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Oak Ridge National Laboratory – Oak Ridge, Tennessee	06/2010 – 08/2010
Higher Education Research Experiences (HERE) Summer Internship	
Purdue University – West Lafayette, Indiana	
Undergraduate Research Assistant (Prof. Thomas Downar)	01/2006 – 08/2006
• Assisted graduate students in writing input files for reactor analysis	
Undergraduate Laboratory Assistant (Prof. Sean McDevitt)	01/2004 – 05/2004
• Worked with other students in setup of a new research laboratory	
North Carolina State University – Raleigh, North Carolina	06/2005 – 08/2005
Undergraduate Assistant at PULSTAR Nuclear Reactor (Prof. Ayman Hawari)	
• Assisted with setup of the Neutron Imaging Facility	
• Designed experiment for neutron absorption standard for Neutron Imaging Facility	
• Assisted with setup of the Neutron Powder Diffractometer	
• Design and build of a pressurized air supply for experiments in the reactor room	
• Performed a flux map of one of the PULSTAR beam tube	

TEACHING EXPERIENCE

University of Michigan

Graduate Student Instructor (NERS 421 – Nuclear Engineering Materials)	Fall 2012
Professor Michael Atzmon	
Graduate Student Instructor (NERS 484 – Radiation Health Effects)	Fall 2011
Professor Kimberlee Kearfott	
Graduate Course Assistant (NERS 522 – Nuclear Fuels)	Winter 2010
Professor Gary Was	

Purdue University

Grader for Undergraduate and Graduate Radiation Laboratory Classes	Fall 2006, Winter 2005
Instructor: Jere Jenkins	

HONORS AND ACTIVITIES

Awards and Scholarships

TMS Young Leaders International Scholar Program with the Korean Institute of Metals and Materials (KIM) - inaugural recipient	2023
TMS Structural Materials Division (SMD) Young Leaders Professional Development	2023
ASTM Emerging Professional D02 Committee	2023
Outstanding Student Oral Presentation, Microstructural Processes in Irradiated Materials Symposia, 2011 TMS annual meeting	2011
Rackham Predoctoral Fellowship Nominee	2011
American Nuclear Society John Randal Memorial Scholarship Recipient	2010
Susan Lipschutz Award Nominee	2010
Marian Sarah Parker Prize Nominee	2010
Rackham Travel Fellowship	2008, 2010, 2011, 2012
Dean's List	2005, 2006
Academic Achievement Award	2002
Fraternal Order of Vikings Scholarship	2002

Societies and Organizations

The Minerals, Metals, and Materials Society (TMS) – lifetime member	2007 – present
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The American Ceramic Society (ACerS) – lifetime member	2007 – present
Materials Research Society (MRS)	2008 – present
American Nuclear Society (ANS) National member – lifetime member	2003 – present
Materials Science and Technology Executive Committee member	2016 – 2019
Michigan section member	2007 – 2014
Purdue University Chapter President	05/2005 – 05/2006
Purdue University Chapter Vice President	01/2005 – 05/2005
American Society for Testing Materials (ASTM) International	2022 – present
The American Society of Mechanical Engineers (ASME)	2022 – present
Women in Nuclear – Oak Ridge Chapter	2014 – present
Tau Beta Pi	2006 – present
Michigan Gamma Graduate Coordinator	01/2009 – 12/2009
Distinguished active, winter 2009 & fall 2009	
Tau Beta Pi -Greater Smoky Mountains Alumni Chapter	2014 – present
President	06/2017-05/2018
ORNL – Early Career Professionals Board Member	2014 – 2018
Young Professionals of Oak Ridge	2014 – 2015
Alpha Nu Sigma National Honors Society (ANSHS)	2005 – 2014
University of Michigan Chapter President	04/2008 – 04/2010
The Epeians – Engineering Leadership Honor Society	2009 –2014
Tau Beta Sigma	2003 – 2006
Purdue University Chapter Treasurer	01/2004 – 12/2004

Volunteer Activities

Tennessee Achieves Mentor	2016
Roane State Tutoring	2014 – 2015
Judge for the Southeast Michigan Science Fair	2009, 2010