

# Peter J. Doyle

1823 Fair Dr.  
Knoxville, TN 37918  
Email: pdoyle3@vols.utk.edu  
Phone: 724-825-4114

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## Education

- **PhD in Nuclear Engineering** **May 2020**
    - University of Tennessee, Knoxville **3.94 GPA**
    - Concentration: Materials
    - Advisor: Dr. Steven Zinkle
    - Thesis Title: Evaluation of the Hydrothermal Corrosion of SiC and the Viability of corrosion Mitigation Coatings in LWR Environments with and without Radiation Effects
  - **MS in Nuclear Engineering** **December 2017**
    - University of Tennessee, Knoxville **3.94 GPA**
    - Thesis topic: Development of a Monte Carlo Model for Defect-Free Channel Formation in Irradiated Materials
  - **BSE in Chemical Engineering** **May 2015**  
**BS in Chemistry** **3.98 GPA**  
Geneva College, Beaver Falls, PA
  - **Nuclear Chemistry Summer School 2013**  
Brookhaven National Laboratory, NY, sponsored by ACS and DOE
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## Research/Work Experience

- **Postdoctoral Research Associate** **November 2020 - Present**
  - Oak Ridge National Laboratory, Oak Ridge, TN
  - Investigation of
    - UO<sub>2</sub> fuel fragmentation as function of burnup and temperature
    - Microscopy of samples exposed to Station Blackout Accident conditions followed by quench
    - Interfacial properties of emerging nuclear fuel concepts
- **Research Specialist III** **May 2020 – November 2020**
  - University of Tennessee, Knoxville, Department of Nuclear Engineering
  - Tasks Include:
    - Perform final outlying research tasks from PhD work and conduct research in various projects related to nuclear materials science and engineering
    - Assist other researchers/graduate students in relevant projects
- **Graduate Research Assistant** **August 2015 – May 2020**
  - University of Tennessee, Knoxville; Department of Nuclear Engineering
  - Accomplishments include:

- Planned and carried out numerous corrosion tests in  $\geq 288^\circ\text{C}$  in oxygenated and deoxygenated tests to gain mechanistic and engineering insights into the corrosion mechanisms of monolithic CVD SiC, and CVD SiC coated with commercial CrN, TiN, and Cr by Physical Vapor Deposition
  - Assisted in deploying, benchmarking, and maintaining a water loop facility at Oak Ridge National Laboratory for corrosion testing in Light Water Reactor-type conditions
  - Oversaw post-irradiation examination and characterization of specimens following neutron irradiation with and without a corrosive environment to determine the viability of mitigation coatings
  - Led broad characterization efforts using transmission and scanning electron microscopy techniques, light microscopy, Raman spectroscopy, atomic force microscopy, and x-ray diffraction
  - Developed a Python routine to calculate the concentrations of products from radiolysis
  - Led development of computer codes in MATLAB and Fortran to evaluate the effect of diffusion on implanted ion profiles in high-damage irradiated materials
  - Planned and oversaw and analyzed data from ion irradiations and post-irradiation examination of pure Cr to understand irradiation effects and provide recommendations on best practices in ion irradiation experiment design
  - Led an interdisciplinary project to improve the application of Transition State Theory to chemical kinetics in the surface sciences
  - Led development of a computer code in Fortran to model the development of defect-free channels in low-temperature irradiated metals
- **Engineering Intern** **Summer 2014**
    - Westinghouse Electric Company, Cranberry and Churchill, PA
    - Developed a model in Excel for the time-to-alarm after a leak develops in a safety relief valve on an LWR pressurizer
    - Compiled databases for valve specifications and design limitations
    - Assisted with testing of a condensate-return testing system for the AP1000 power plant

### Peer-Reviewed Journal Articles (ORCID 0000-0002-1182-0034)

1. **P.J. Doyle**, S.S. Raiman, S.J. Zinkle, Void Swelling of Cr in Light Water Reactor Environments Using 15MeV Ni Ions, **Manuscript in Progress**
2. **P.J. Doyle**, Stephen S. Raiman, Steven Zinkle, Evaluation of the Viability of First-Generation Corrosion Mitigation Coatings on SiC for Accident-Tolerant Fuel Cladding in the Absence of Irradiation, **Accepted**
3. **P.J. Doyle**, Stephen S. Raiman, Steven Zinkle, Hydrothermal Corrosion Behavior of CVD SiC in High Temperature Liquid Water with and Without Dissolved Oxygen, *Journal of Nuclear Materials*, 539 (2020) 152241
4. **P.J. Doyle**, D. Bartels, Python Script for Homogeneous Aqueous Chemical Reaction Analysis with Specific Application to Radiolysis, *Data in Brief*, 31 (2020) 105734
5. **P.J. Doyle**, C. Ang, T. Koyanagi, Y. Katoh, S.S. Raiman, Evaluation of First-Generation Corrosion-Mitigation Coatings on SiC for Accident-Tolerant Fuel Cladding, *Journal of Nuclear Materials*, 536 (2020) 152203

6. **P.J. Doyle**, Kaicho Sun, Lance Snead, Yutai Katoh, David Bartels, Steven. Zinkle, Stephen Raiman, The Effects of Neutron and Ionizing Irradiation on the Aqueous Corrosion of SiC, *Journal of Nuclear Materials*, 536 (2020) 152190
  7. **P.J. Doyle**, A. Savari, S.S. Raiman, Extracting meaningful standard enthalpies and entropies of activation for surface reactions from kinetic rates, *Reaction Kinetics, Mechanisms and Catalysis*, 129 (2020) 551-581
  8. P.A. Mouche, C. Ang, T. Koyanagi, **P. Doyle**, Y. Katoh, Characterization of Cr, CrN, and TiN coatings on SiC, *Journal of Nuclear Materials*, 527 (2019) 151781
  9. S.S. Raiman, **P.J. Doyle**, C. Ang, Y. Katoh, K.A. Terrani, Hydrothermal Corrosion of Coatings on Silicon Carbide in Boiling Water Reactor Conditions, *Corrosion*, 75 (2019) 217-223.
  10. **P.J. Doyle**, K.M. Benensky, S.J. Zinkle, Impact of Radiation-Enhanced Diffusion on Implanted Ion Profiles, *Journal of Nuclear Materials*, 509 (2018) 168-180.
  11. **P.J. Doyle**, K.M. Benensky, S.J. Zinkle, A Set of MATLAB Routines and Associated Files for Prediction of Radiation-Enhanced Diffusion in Ion Irradiated Materials, *Data in Brief* 21 (2018) 83-85.
  12. **P.J. Doyle**, K.M. Benensky, S.J. Zinkle, Modeling of dislocation channel width evolution in irradiated metals, *Journal of Nuclear Materials* 499 (2018) 47-64.
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## Conference Proceedings

1. **P.J. Doyle**, S.S. Raiman, C. Ang, Y. Katoh, S. Zinkle, "Evaluation of the Corrosion Kinetics of SiC with and without Mitigation Coatings in LWR Chemistries", in: *Proceedings of the 19th International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors*, Boston, MA, August 18-22, The American Nuclear Society (2019).
  2. S.S. Raiman, **P.J. Doyle**, C. Ang, T. Koyanagi, D. Carpenter, K. Terrani, Y. Katoh, "Irradiation-Induced Cracking of Dual-Purpose Coatings on SiC", in; *Proceedings of the 19th International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors*, Boston, MA, August 18-22, The American Nuclear Society (2019).
  3. **P.J. Doyle**, S.S. Raiman, R. Rebak, K.A. Terrani, "Characterization of the Hydrothermal Corrosion Behavior of Ceramics for Accident Tolerant Fuel Cladding", in: J.H. Jackson, D. Paraventi, M. Wright (Eds.), *Proceedings of the 18th International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors*, Portland, OR, August 13-17, The Minerals, Metals & Materials Society (2017).
  4. S.S. Raiman, C. Ang, **P.J. Doyle**, K.A. Terrani, "Hydrothermal Corrosion of SiC Materials for Accident Tolerant Fuel Cladding with and Without Mitigation Coatings", in: J.H. Jackson, D. Paraventi, M. Wright (Eds.), *Proceedings of the 18th International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors*, Portland, OR, August 13-17, The Minerals, Metals & Materials Society (2017).
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## Contributed Oral Presentations

1. P.J. Doyle, Takaaki Koyanagi, Steven Zinkle, Benefits of Using High Energy Ions in Ion Irradiation Experiments to Evaluate Void Swelling, MS&T 2020, Virtual, November 3-6, 2020
2. **P.J. Doyle**, Stephen Raiman, Steven Zinkle, Evaluation of the Corrosion of High Purity CVD SiC in Light Water Reactor Environments, MS&T 2020, Virtual, November 3-6, 2020
3. **P.J. Doyle**, Takaaki Koyanagi, Caen Ang, Yutai Katoh, Steven Zinkle, David Carpenter, Stephen Raiman, Radiation Effects on the Aqueous Compatibility of Coated and Uncoated SiC for Accident-Tolerant Fuel Cladding in Light Water Reactors, TMS 2020 Annual Meeting and Exhibition, San Diego, CA, February 23-27, 2020
4. **P.J. Doyle**, Stephen Raiman, Application of Empirical Transition State Theory to Corrosion of SiC in Light Water Reactors, 44<sup>th</sup> International Conference and Exposition on Advanced Ceramics and Composites, Daytona Beach, FL, January 26-31, 2020
5. **P.J. Doyle**, T. Koyanagi, C. Ang, Y. Katoh, S.J. Zinkle, D. Carpenter, S.S. Raiman, "Radiation Effects on the Aqueous Compatibility of Coated and Uncoated SiC for Accident-Tolerant Fuel Cladding in Light Water Reactors", Materials in Nuclear Energy Systems, Baltimore, MD, October 6-10, 2019
6. **P.J. Doyle**, S.S. Raiman, C. Ang, Y. Katoh, S.J. Zinkle, "Evaluation of the Corrosion Kinetics of SiC with and without Mitigation Coatings in LWR Chemistries", 19<sup>th</sup> International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors, Boston, MA, August 18-22, 2019
7. **P.J. Doyle**, K.A. Terrani, Y. Katoh, S.S. Raiman, S.J. Zinkle, "Characterization of the Hydrothermal Corrosion Behavior of SiC With and Without Corrosion Mitigation Coatings", TMS 2019, San Antonio, TX, March 10-14, 2019
8. **P.J. Doyle**, K.A. Terrani, Y. Katoh, C. Ang, S.S. Raiman, and S.J. Zinkle, "The Effect of Dry Neutron Irradiation on SiC Coated with TiN, CrN, and Cr", 43<sup>rd</sup> International Conference and Exposition on Advanced Ceramics and Composites, Daytona Beach, FL, January 27-February 1, 2019
9. **P.J. Doyle**, K.M. Benensky, and S.J. Zinkle, "Impact of Irradiation-Enhanced Diffusion on Implanted Ion Profiles", TMS 2018, Phoenix, AZ, March 11-15, 2018
10. **P.J. Doyle**, S.S. Raiman, K.A. Terrani, and R. Rubak, "Characterization of the Hydrothermal Corrosion Behavior of Ceramics for Accident Tolerant Fuel Cladding", 42<sup>nd</sup> International Conference and Exposition on Advanced Ceramics and Composites, Daytona Beach, FL, January 28-February 2, 2018
11. **P.J. Doyle**, S.S. Raiman, K.A. Terrani, and R. Rubak, "Characterization of the Hydrothermal Corrosion Behavior of Ceramics for Accident Tolerant Fuel Cladding", 18<sup>th</sup> International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors, Portland, OR, August 13-17, 2017
12. **P.J. Doyle**, K.M. Benensky, and S.J. Zinkle, "Computer Simulation of Defect-free Channel Formation by the Monte Carlo Method", TMS 2017, San Diego, CA, February 27-March 2, 2017

## Technical Skills

- Materials characterization:
  - Topographical Atomic Force Microscopy
  - Scanning Electron Microscopy – General Microscopy, Electron Backscatter Diffraction (EBSD), Transmission Kikuchi Diffraction (TKD), and Energy Dispersive Spectroscopy (EDS)

- Raman Spectroscopy
    - X-ray Diffraction
  - Programming:
    - Python
    - MATLAB
    - Fortran
    - Microsoft Excel's VBA
  - Understanding of radiation damage processes and effects
  - Understanding of chemical corrosion and kinetic processes
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## Memberships and Awards

- Recipient of the PhD Graduate Research Excellence Award from the Department of Nuclear Engineering, University of Tennessee, Knoxville, 2020
- Recipient of the U.S. Department of Energy, Office of Nuclear Energy's 2019 Innovations in Nuclear Technology R&D Award in Advanced Reactor Systems, Second Place.
- Finalist, National Nuclear Security Administration's Division of Naval Reactors (NNSA-NR) Rickover Fellowship Program in Nuclear Engineering, 2017
- U.S. Department of Energy, Office of Nuclear Energy, one-year Integrated University Partnership Graduate Fellow, 2016-2017
- Recipient of the Society of Analytical Chemists of Pittsburgh 2014-2015 College Chemistry Award; Geneva College
- Recipient of the American Chemical Society Division of Analytical Chemistry Undergraduate Award in Analytical Chemistry – 2013, 2014, 2015
- Recipient of the Lola G. Duff and William H. Duff, II merit scholarship 2013-2015
- Member of ANS, and Material Advantage (ACerS, AIST, ASM, and TMS)
- Member of the Alpha Nu Sigma and the Alpha Chi honor societies