Postdoctoral Research Associate in Ion Beam Modification and Analysis

The Department of Mechanical and Materials Engineering (MME) at Queen's University, Canada, invites applications for a full-time Postdoctoral Research Associate position to join the Canada Excellence Research Chair (CERC) Program in Impact of Radiation in Energy and Advanced Technologies, a federally funded $8M initiative led by Prof. Yanwen Zhang. Interested applicants should contact Prof. Zhang directly at yanwen.zhang@queensu.ca with a cover letter, CV, and names of two referees.

Project Opportunity

This project focuses on advancing the understanding of radiation effects in complex materials, including high-entropy alloys (HEAs) and high-entropy ceramics (HECs). The chemical complexity arising from local elemental variation creates diverse and tunable bonding environments, often not achievable in conventional materials. Under extreme conditions, such as ion irradiation, these materials exhibit unique non-equilibrium responses driven by substitutional disorder and complex energy dissipation mechanisms.

Ion beam modification and analysis techniques are central to this research, enabling controlled introduction of radiation damage, as well as *in situ* and *ex situ* characterization of defect formation and damage evolution, and microstructural responses. By combining ion irradiation with advanced characterization, this work aims to uncover the fundamental mechanisms linking chemical disorder and defect behavior to materials performance under irradiation. The ultimate goal is to support the development of radiation-tolerant materials for nuclear energy systems and other advanced technologies operating in extreme environments.

The RE-MAT (Radiation Effects in Materials and Advanced Technologies) team, based within the Canada Excellence Research Chair (CERC) Program and the Queen's Nuclear Materials Group, integrates experimental research with computational modeling. Utilizing the capabilities of the Reactor Materials Testing Laboratory (RMTL) at Queen's University (Reactor Materials Testing Laboratory | Queen's University), and collaborating with national laboratories, academic partners, and industry, this research aims to accelerate materials innovation and contribute to Canada's low-carbon energy future.

Role Description:

The successful candidate will design, execute, and analyze ion irradiation experiments to investigate radiation-induced defect processes in complex alloys and ceramics. Working closely with Prof. Zhang and the RE-MAT research team, the candidate will carry out light and heavy ion irradiations across a range of energies and temperatures, focusing on both nuclear and electronic energy deposition mechanisms. Resulting defect formation, clustering, dislocation structures, and elemental segregation will be studied, with particular attention to the role of chemical complexity.

The candidate will collaborate with modeling colleagues to correlate experimental observations with computational predictions, refining mechanistic understanding of defect evolution and radiation damage processes. Responsibilities include leading data analysis, preparing technical reports, and authoring peer-reviewed publications, as well as presenting findings at international conferences. This

position offers substantial opportunities for scientific leadership within a growing research team and professional development in experimental ion beam research applied to nuclear materials.

Duties/Responsibilities:

- Perform ion irradiations using a variety of ion species (e.g., H, He, Ni, Au) at controlled temperatures to simulate radiation environments.
- Conduct Rutherford Backscattering Spectrometry (RBS) in both random and crystalline/channeling directions, Elastic Recoil Detection Analysis (ERDA), and other surface and microstructural characterization techniques to assess composition, crystallinity, and radiation-induced structural changes.
- Work collaboratively within the RE-MAT team and with external partners to integrate experimental findings into broader materials development objectives.
- Collaborate with team members to maintain a high level of scientific productivity. Lead the preparation of journal publications and conference presentations in a timely manner.
- Ensure compliance with safety, environmental, and quality standards in all research activities.

Qualifications:

- PhD in Materials Science and Engineering, Nuclear Engineering, Physics, or a closely related field, with a strong focus on ion beam techniques and radiation effects in materials; must have completed all degree requirements before starting the appointment and be within four years of receiving their doctorate.
- Minimum of three years of hands-on experience in ion irradiation experiments and ion beam analysis.
- Demonstrated understanding of radiation damage processes, ion-solid interactions, and microstructural evolution in alloys or ceramics.
- Strong publication record in peer-reviewed journals relevant to radiation effects.
- Experience working at ion accelerator facilities or in radiation environments is highly desirable.
- Excellent project management and communication skills, with the ability to work both independently and within multidisciplinary teams.
- Motivated, safety-conscious, and capable of innovative, independent research contributing to broader collaborative goals.

Application Process:
Queen's University is committed to equity, diversity, and inclusion. We encourage applications from all qualified individuals. Please submit a cover letter, CV (including a full publication list), and contact information for two referees to Prof. Yanwen Zhang at yanwen.zhang@queensu.ca. Applications will be reviewed on a rolling basis until the position is filled.