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UROP Proposal Fall 2014

Neutron Studies of Hydrogen Retention in Highly Radiation-Damaged Structural Materials for Nuclear Reactors

Project Overview

One important field of research in the Nuclear Engineering community is the response of materials to the harsh environment of nuclear power reactors, knowledge of which directly affects the needs and designs of existing and future nuclear systems. This project seeks to answer the long-standing question of where and how much hydrogen gas is trapped within structural materials after irradiation in fission and fusion reactors, and how this trapped hydrogen affects mechanical properties. Since it is difficult and expensive to acquire and experiment on highly radiation-damaged materials, this project proposes to produce model materials without neutron irradiation. My UROP will focus on building such materials with large numbers of isolated Helium bubbles and charged with Hydrogen atoms.

Personal Role & Responsibilities

My role in this project is to make the model materials. This will be done through producing layers of material with cavities to simulate the bubbles and then pressing the layers together at high temperatures to form diffusion bonds. I will be learning how to do this, experimenting with the process, and actually creating the materials at MIT's Microsystems Technology Lab. In addition, Dr. Khaykovich has scheduled time at SNS, the Spallation Neutron Source Facility at Oak Ridge National Laboratory in Tennessee in December to test these model materials.

Goals and Personal Statement

The goal of this project is to demonstrate a novel approach to investigate radiation-damaged materials. I am excited to get to learn some basic metallurgy and to get more experience in the experimental aspect of research. It will also be exciting to test the materials at SNS, which will give me a unique chance to experience a bigger research setting outside of MIT. The experimental part of the project will also be balanced out by the analytical part after testing the materials, and I'm attracted to this balance of a broader and more complete research experience. I am sure I will gain meaningful research experience and learn a lot about how hydrogen retention affects radiation-damaged materials, which will be useful knowledge, as I would like to work in nuclear energy in the future. Furthermore, working with Dr. Khaykovich and Prof. Short will be a good chance to get to know the faculty in my department better, and to learn more about the Nuclear Science and Engineering field from them. I think they will both be great mentors, and I think I will appreciate their guidance, advice, and mentorship. I also hope my experience in this project will give me a better sense of how research is done and leave me with more confidence in pursuing it with a more independent approach in the future. As a junior, I also hope

this project will help me decide whether I want to pursue a PhD/Master's degree or go into industry after I graduate.