

## **Nuclear Engineering Seminar**

### **Dr. Lei Cao**

*The Ohio State University*

**Wednesday, January 23, 2019**

**3:30pm | PHYS 112**

### **Development of WBG sensors for applications in extreme environment: fuel cycle and battery**

#### **Abstract**

The vulnerability of a closed fuel cycle stems from the risk of diverting special nuclear materials (SNM) for ill-purposed use. The ability to monitor actinides to prevent and detect the misuse of SNM throughout the pyro-processing flowsheet is of paramount concern to global nuclear security. There is a critical need to monitor the concentration of actinides in the molten salt, and preferably this monitoring tool should involve an on-line method. While a few promising approaches have been proposed, none have yet been proven to be both practically implementable and sufficiently accurate. We are developing a sensor prototype based on wide band-gap (WBG) semiconductor materials for the measurement of actinide concentrations in molten salt at a high temperature. The novel approach uses in-salt electro-deposition to pre-concentrate actinides onto a sensor before measurement, the benefit of which over voltammetry is the improved ability to quantify specific actinides that might have similar electrochemical reduction potentials and even isotopes that are electrochemically indistinguishable. A group of SiC schottky devices has been fabricated from commercial off-the-shelf wafers. The sensors function well at 500 °C with only a slightly degraded resolution. Notably, the sensor is also capable of being a nuclear voltaic battery to harvest energy from radiation or to be self-powered sensors.



Dr. Lei Raymond Cao is Professor in the Nuclear Engineering Program at The Ohio State University (OSU) and the Director of OSU-Nuclear Reactor Lab. Dr. Cao received his PhD degree from University of Texas at Austin in May 2007. Prior to joining OSU, Dr. Cao was a research associate at Positron Emission Tomography lab at Harvard Medical School and then at the Center for Neutron Research, U.S. National Institute of Standards and Technology (NIST) at Maryland. Dr. Cao's major research interests focus on nuclear instrumentation and sensor development, in-pile instrumentation, radiation effects, and nuclear analytical technologies. Dr. Cao has published ~ 120 peer-reviewed journal articles and conference proceedings. Dr. Cao is the on the executive committee of Isotope and Radiation Division (IRD) at the American Nuclear Society and also served the IRD chair during 2015-2016, he is also serving as Associate Editor for IEEE Transactions on Nuclear Science.