Research and Teaching Equipment for Nuclear Materials Characterization

PI: Peter Hosemann- University of California, Berkeley

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ABSTRACT:

Fundamentally, the materials available to the engineers and scientists limit new and potentially dramatically better engineering applications. Therefore it is essential to investigate and understand materials degradation in the environment relevant to the application in order to reach the full potential for a given technology. This is especially true for nuclear engineering since the unique challenges a nuclear environment provides makes materials selection and materials qualification especially difficult.

The microstructure governs the mechanical properties of materials and therefore both the microstructure and mechanical properties need to be investigated in parallel to develop a sound scientific understanding of the changes a material goes through in a radiation environment. Having the proper equipment to perform mechanical and microstructural measurements on relevant materials for nuclear applications is needed for both research and training of nuclear engineers. The strength of this infrastructure upgrade is therefore the comprehensive nature of the structure property relationship.

Upgrading the nuclear materials characterization capabilities at U.C. Berkeley, the only nuclear engineering department in California, is essential to guarantee the best education for the next generation of nuclear engineers. The students need to be trained on state-of-the-art equipment of the same kind as they will find in national laboratories and the nuclear industry when they leave school. Also, utilizing this new equipment for novel research conducted by students and postdocs as well as visiting scientist in an academic environment will lead the way to new materials solutions for nuclear power applications. The combination of basic scientific investigation methods (atomic force microscopy, micromechanical testing, and scanning transmission electron microscopy) and engineering scale approaches (tensile-compression testing in reactor relevant environments) will give the students an applied education including hands on experiences that will complement their fundamental scientific studies in the classroom and in their research.

It is the UC-Berkeley Nuclear -Materials -Engineering mission to combine basic nuclear material science with application and engineering oriented needs delivering a scientific based engineering solution founded on experimental results through mechanistic understanding

The fact that U.C. Berkeley has a valid site license to handle radioactive materials and existing laboratories leverages our proposed new instruments and upgrades for the maximum output for materials under extremes including radioactive materials. Our proposed infrastructure will also attract more outside users from national laboratories, other universities and industry to U.C. Berkeley thereby increasing the visibility and output of the nuclear engineering department nationally and internationally. All of the results obtained with this new equipment will be reported in the open literature and peer-reviewed journals with proper acknowledgment to the funding agency. Special attention will be given to the DOE reporting and the journal of nuclear materials.