Research and teaching equipment for nuclear materials characterization

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ABSTRACT:
A fundamental understanding of materials in their natural environment and as deployed in structures is at the core of all engineering applications especially nuclear engineering due to the fact that any nuclear component and design can only be realized if the materials are available and reliable. 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 any given nuclear technology.
One of the main concerns of all nuclear engineering applications are the structural integrity of the component while optimizing for physical properties such as thermal properties. All macroscale properties of a material are governed by the nano-and micro-scale features in the materials. Therefore being able to probe the local properties of a material leads to fundamental understanding of the materials performance as a whole and further improvements become accessible. In addition the fact that nuclear materials research often times deals with rather small sample sizes in order to keep the specimen activity to a minimum or to access ion beam irradiated regions of interest also calls for small scale sample probing. Therefore this proposal asks for infrastructure enabling to push the envelope in research and increase the width in teaching on nuclear engineering relevant materials while also improving safety for the workers involved. This proposal bridges across several length scales from the true nanoscale to the macro scale while keeping safety in mind.
UC-Berkeley is the only nuclear engineering department in California and one of the smallest departments. However, especially the materials characterization and investigation of reactor relevant materials has been one of the departments main focus of decades. Upgrading the nuclear materials characterization capabilities at U.C. Berkeley, is essential to guarantee the best education for the next generation of nuclear engineers and keep the department competitive in the future. The students need to be trained on state-of-the-art equipment of the same kind as they will find it in national laboratories and the nuclear industry when they leave school. Also, utilizing 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 with enhanced safety measures 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
In 2015 a new laboratory was built to handle and prepare activated samples as well as perform basic measurements on them. Our proposed high temperature in-situ nanomechanical, in-situ tensile testing, scanning probe controller, hand –foot detector and ultrasonic non-destructive testing equipment 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.