DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-17-050

SECTION A. Project Title: Radiation Resistant High Entropy Alloys for Fast Reactor Cladding Applications – University of Wisconsin

SECTION B. Project Description

The University of Wisconsin proposes to investigate the radiation damage performance of high entropy alloys (HEA) as promising "out of the box" class of metallic materials for sodium-cooled fast reactor (SFR) cladding and other in-core applications. The focus will be on radiation damage effects on the microstructure in this class of alloys at high temperatures and dpa (displacements per atom) levels, but this project will also include mechanical property measurements of irradiated layers (up to operational temperatures) and corrosion performance of the alloys in high temperature liquid sodium environment. To accomplish the proposed research in-depth and within the time-lines of the project, two types of HEAs, one based on 3d transition metals CrFeMnNi (face centered cubic structure) and the other based on light refractory metals NbTaTiVZr (body centered cubic structure) will be investigated. The alloys will be prepared by various processes, including arc melting, vacuum induction melting and field assisted sintering, which are available across the partnering institutions, and the processes yielding the most promising microstructures will be used for irradiation studies. Irradiations will be performed using protons, heavy ions, and dual beam (He + heavy ion) irradiations over a range of temperatures and dpa levels, intended to induce a wide range of irradiation damage mechanisms in the alloys. Precise mesoscale and nano-structural and nano-compositional characterizations and mechanical properties assessments will be performed.

SECTION C. Environmental Aspects / Potential Sources of Impact

The university has procedures in place to handle any waste that will be generated through this project. The action would not create additional environmental impacts above those already permitted at the university.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B; give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not "connected" nor "related" (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial development.

B3.10 Siting, construction, modification, operation, and decommissioning of particle accelerators, including electron beam accelerators, with primary beam energy less than approximately 100 million electron volts (MeV) and average beam power less than approximately 250 kilowatts (kW), and associated beamlines, storage rings, colliders, and detectors, for research and medical purposes (such as proton therapy), and isotope production, within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible), or internal modification of any accelerator facility regardless of energy, that does not increase primary beam energy or current. In cases where the beam energy exceeds 100MeV, the average beam power must be less than 250 kW, so as not to exceed an average current of 2.5 milliamperes (mA).

Justification: The activity consists of university-scale research aimed at investigating radiation damage performance of high entropy alloys.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on 06/29/2017