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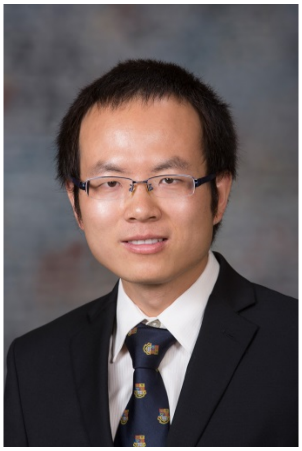

Investigator: Bai Cui

Position Title: Assistant Professor

Department: Mechanical & Materials Engineering

Email: bcui@unl.edu

Phone: (402) 472-5740

Webpage: http://engineering.unl.edu/mme/faculty/bai-cui/

Novel Irradiation and Stress Corrosion Cracking Resistant Oxide-Dispersion-Strengthened Alloys

Abstract.

The ***overall goal*** of the proposed research is to develop new types of oxide-dispersion strengthened(ODS) alloys that are resistant to stress corrosion cracking (SCC) and irradiation damage using laser shock peening (LSP). Candidate materials for Generation-IV nuclear reactors must operate under extremely high levels of radiation damage, high temperatures, and corrosive coolants. ODS austenitic alloys are promising candidates, but they still suffer SCC problems in the corrosive coolants. The proposed project aims to fill this ***gap*** in the research.

Recent findings show that LSP can generate compressive residual stresses into surfaces, which effectively mitigate SCC of austenitic stainless steels. The first ***hypothesis*** is that LSP can also prevent SCC of ODS austenitic alloys by inducing compressive stresses. In addition, LSP results in an increased density of dislocations and grain boundaries in the microstructures. In the preliminary study, *in situ* transmission electron microscopy (TEM) irradiation experiments have shown that during heavy ion irradiation, these dislocations and grain boundaries serve as sinks for the annihilation of irradiation defects. The second ***hypothesis*** is that LSP can further improve the irradiation resistance of ODS alloys by providing more defect sinks.

To fulfill the overall goal, the following ***scientific objectives*** will be pursued: (1) determine the effect of LSP on SCC of ODS alloys in the high-temperature water coolant; (2) identify the effect of LSP on the irradiation defect generation, growth, and migration in ODS alloys; (3) determine the mechanisms for the prevention of SCC by LSP; and (4) optimize the LSP parameters for better mitigation of SCC and irradiation damage. The ***rationale*** is that an understanding of the underlying mechanisms of LSP will enable the lifetime of Generation-IV nuclear reactor components to be extended, which will be a significant ***contribution*** to the use of materials in high temperature extreme applications.