Nebraska Center for Materials and Nanoscience

2017 Fall Seminar Series

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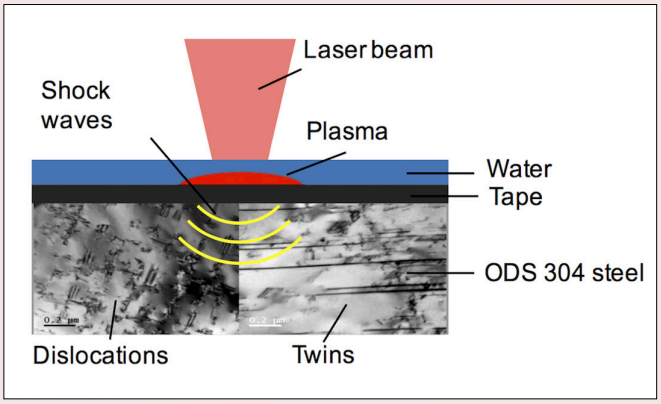
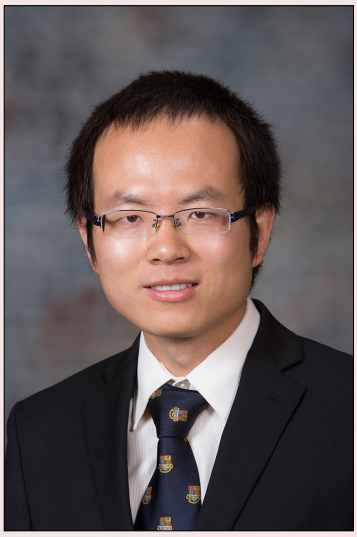
Laser Shock Processing of Metals and Ceramics: Preventing Material Failures by Surface Engineering

Laser shock processing (LSP) is a novel surface engineering technique, which utilizes a nanosecond laser to generate plasma-driven shock waves that can induce high compressive residual stresses extending to a depth of more than 1 mm from the surface. Our research has discovered that LSP can prevent the stress corrosion cracking (SCC) of austenitic steels in chloride-rich hot water environment, and improve the irradiation resistance of oxide-dispersion-strengthened (ODS) alloys for Generation-IV nuclear energy systems. The mechanisms in metals are related to the compressive residual stresses, plastic deformation, and defect sinks generated by LSP. Compared to metals, LSP has not been widely applied to ceramics and its effects and mechanisms on ceramics are less understood. LSP of polycrystalline alumina ceramics induce localized plastic deformation along grain boundaries.



The presence of compressive residual stress can improve the resistance of ceramics to surface-originated crack growth, which may lead to new toughening mechanisms for ceramics.



Dr. Bai Cui leads the Materials for Extreme Environments Lab at UNL. He received his Ph.D. degree in materials from Imperial College London in 2011, and was a postdoctoral associate at the University of Illinois at Urbana-Champaign. His research was recognized by the Richard Brook Prize for Best Ph.D. in Ceramics in the UK and the Guastv Eirich Award from the European Centre for Refractories. His research interests include materials for extreme environments, advanced manufacturing, corrosion, irradiation damage, and in-situ electron microscopy.

December 6 | 4 p.m.
136 Jorgensen Hall