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Effects of nanoscale chemical heterogeneity on the wear, corrosion, and tribocorrosion resistance of Zr-based thin film metallic glasses

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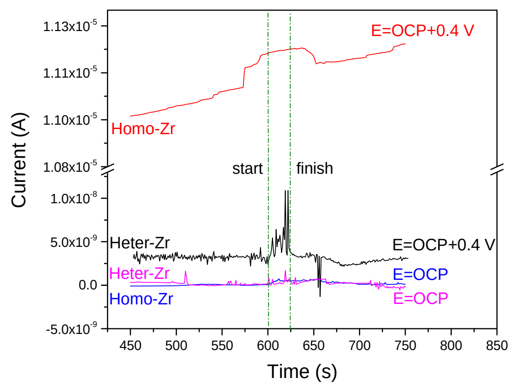
Abstract



Current evolution of Zr-based thin film during tribocorrosion.

The effects of nanoscale chemical heterogeneity on the wear, corrosion, and tribocorrosion resistance of ZrCuNiAl thin film metallic glasses were investigated by examining samples of similar global composition but with either homogenous or heterogeneous local composition. Unlike the homogenous sample, the heterogeneous sample exhibited local compositional fluctuations of Zr-rich (~52.8 at. %) and Zr-lean (~51.7 at. %) regions separated by ~413.0 ± 64.7 nm. Dry scratch wear study showed that the homogenous samples exhibited lower wear rates and friction coefficients than their heterogenous counterparts due to their higher hardness and lower stiffness, as measured from nanoindentation tests. Corrosion resistance of both samples was studied through potentiodynamic polarization and Mott-Schottky analysis in 0.6 M NaCl aqueous solution under room temperature. It was found that the heterogeneous samples exhibited higher pitting resistance than their homogenous counterparts by forming a protective passive layer with lower defect density. Finally, the effects of chemical heterogeneity on the tribocorrosion rate and repassivation kinetics of both samples were discussed based on their differences in mechanical and electrochemical properties measured.

Biography

Wenbo Wang obtained his master's degree at University of South Florida in 2017. He is pursuing his Ph.D. degree in Dr. Cai's group at Virginia Tech since fall 2018. His research focuses on understanding the corrosion and tribocorrosion mechanism of metals and coatings using electrochemical measurements, tribocorrosion testing and advanced materials characterization.