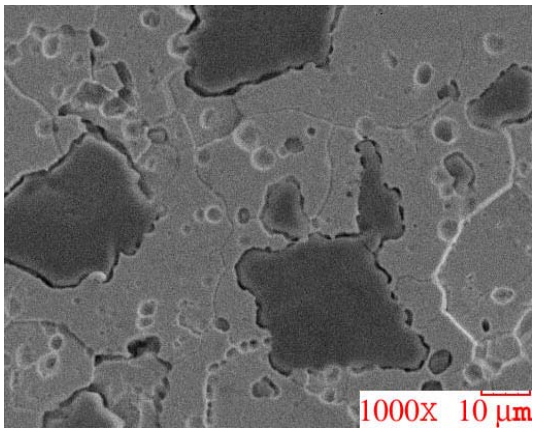
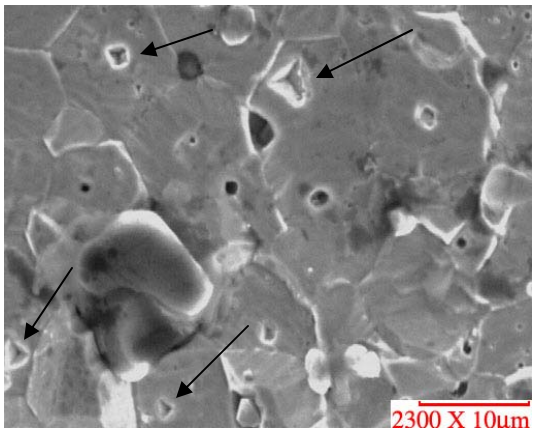
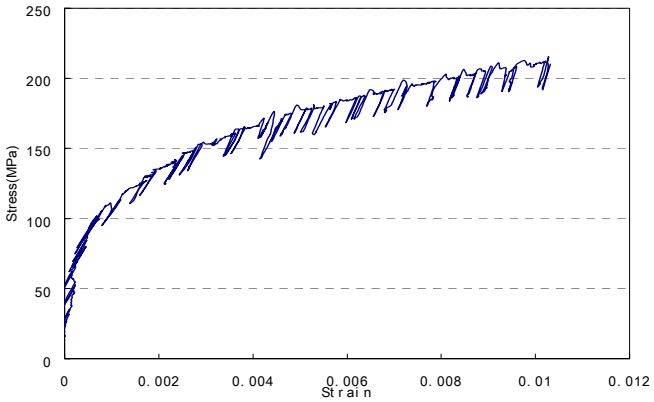


Spinel particle and molybdenum matrix debonding due to thermal cycle



Matrix microcracks due to interaction between large spinel particles and molybdenum matrix during thermal cycling



Jitters on the stress-strain curve (Mo-6wt%$MgAl_2O_4$) due to CTE mismatch between large spinel particles and molybdenum matrix at 650 C

MATERIALS	PROCESSING CONDITION
Mo	Mo powder (2-8 m) Hot pressed/1800ºC/Vaccum/3ksi/1h
Mo-3wt%$MgAl_2O_4$	Mo powder (2-8 m) 3 wt% $MgAl_2O_4$ (Spinel) Hot pressed/1800ºC/Vaccum/3ksi/1h
Mo-6wt%$MgAl_2O_4$	Mo powder (2-8 m) 6 wt% $MgAl_2O_4$ (Spinel) Hot pressed/1800ºC/Vaccum/3ksi/1h
Mo-3wt%MgO	Mo powder (2-8 m), 3 wt% MgO Hot pressed/1800ºC/Vaccum/3ksi/1h

Material matrix

Integrated Research For Predicting Higher Dimensional Phase Diagrams With Emphasis on Ternary Diagrams of Molybdenum, Silicon, and Boron

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Benedum Professor of Physics Bernard R. Cooper, Department of Physics, West Virginia University, and
Dr. Joachim H. Schneibel, Metals and Ceramic Division, Oak Ridge National Laboratory.

The objective of this collaborative research work between West Virginia University (WVU) and Oak Ridge National Laboratory (ORNL) is to develop and evaluate behavior of molybdenum silicide alloys for land-based power plant turbines able to withstand temperature exceeding 1000ºC. We have conducted computational modeling studies of ternary system of Molybdenum, Silicon and Boron over a wide range of temperature. Our current research effort is on ductilizing the Mo phase by dispersing $MgAl_2O_3$ spinel particles. Mo alloys with different volume fractions of spinel particles are processed at ORNL, and the related fracture and mechanical properties as well as the atomic structure of the spinel are then investigated at WVU. The spinel particles can cause several competing effects: (1) particles as crack nucleation sites – embrittlement, (2) particles as dislocation nucleation sites – ductilization, and (3) particles or particles interfaces as getters of detrimental impurities such as oxygen. Currently, the effect of large spinel particles to material ductility are being studied.

Read more about this project.