The overarching goal of this task is to employ advanced characterization techniques to deduce the effect of chemistry and processing on the dynamic performance of boron carbide. We serve as the eyes for the Cross Cutting Task B: Materials Synthesis & Processing. More specifically we will provide microstructural insight at the nanoboron carbide. We serve as the eyes for the Cross Cutting Task B: Materials Synthesis & Processing.

Key Goals

The key goals are to:

1. Probe the relative bond strength in B₄C using atom probe tomography
2. Calculate bond characteristics of dodecahedral borides
3. Probe the relative bond strength in B₄C using atom probe tomography

Research highlight 1: B-rich boron carbide

1. Boron content ↑, Planar defects ↑
   - Few planner defects
   - Profuse stacking faults
   - Numerous twins

Research highlight 2: Si-doped B₄C

1. Si did not diffuse into boron carbide by Si (10 wt.%) and B₄C co-sintering
   - No boron carbide peak shift suggests the absence of Si-doping
   - The added Si formed SiC and borosilicate glass instead of doping in B₄C
   - High defect density in Si-doped boron carbide
   - The Si-content measured in the Si-doped boron carbide in the SiB₆ end is ~3.5 at.%

Research highlight 3: chemical bonding

1. Probe the relative bond strength in B₄C using atom probe tomography
2. Calculate bond characteristics of dodecahedral borides
3. Probe the relative bond strength in B₄C using atom probe tomography

Impact

- We provide experimental microstructural information on boron carbide to guide processing and to validate simulations for our Consortium collaborators.
- We serve as the eyes for our ARL collaborators to understand the microstructure and damage evolution in boron carbide, which contributes to the design of next generation boron compound based body armor.

Technical Approach

We employ the state of the art characterization techniques such as TEM (including STEM, HRTEM, EDS, EELS, etc) and atom probe tomography to offer nano-scale and atomic-level understanding of the microstructure and the fundamental failure mechanisms of boron carbide and other dodecahedral super-hard ceramics.

Materials-by-Design Process

- Mechanism-based Approach
- Materials-by-Design Process (including STEM, HRTEM, EDS, EELS, etc) and characterization techniques such as TEM
- We employ the state of the art characterization techniques such as TEM (including STEM, HRTEM, EDS, EELS, etc) and atom probe tomography to offer nano-scale and atomic-level understanding of the microstructure and the fundamental failure mechanisms of boron carbide and other dodecahedral super-hard ceramics.

Selected MEDE related publications: