



U.S. ARMY
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TEM Characterization of Deformation
Mechanisms in Sharp-Indented Ceramics

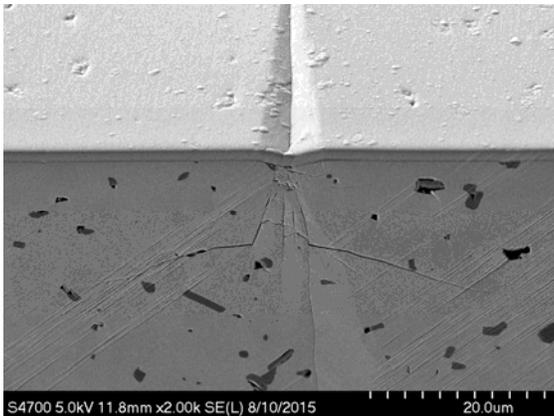


S&T Campaign: Materials Research *High Strain and Ballistics*

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Research Objective

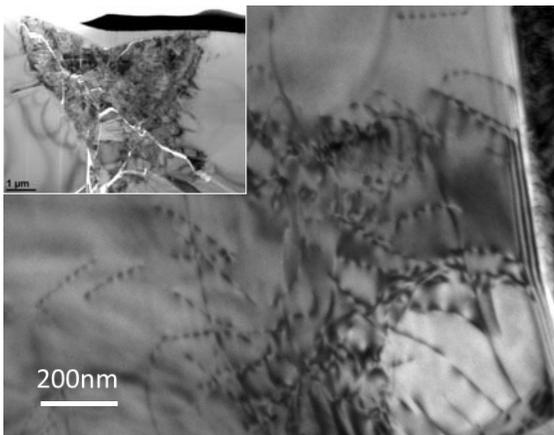
- Reveal and understand the nature of deformation mechanisms in silicon carbide ceramic materials by comparing the affects of Knoop indentions on SiC materials manufactured by various processing methods.
- Deformations so far seen are typically not seen in ceramic materials but are more common in metals.



SEM micrograph of indent and cracking after masked ion milling

Challenges

- Holding in place plastically deformed, cracked and broken material in volumes on the order of 10's of microns in dimension.
- Preparing small volume samples for TEM analysis.
- Identifying which deformation mechanisms are occurring.



TEM micrographs showing dislocation network near a grain boundary and inset showing location of tip indent as well as elastic and inelastic deformation zones

ARL Facilities and Capabilities Available to Support Collaborative Research

- JEOL 2100F Transmission Electron Microscope
- Gatan EELS and EFTEM Imaging Systems
- High Angle Annular Dark Field Detector (HAADF)
- STEM Imaging System
- FEI NanoLab Dual Beam Focused Ion Beam (FIB)
- Hitachi S-4700 Scanning Electron Microscope (SEM)
- FEI NanoSem 600 Environmental SEM
- Leica TIC-3X Masked Ion Milling System
- Gatan Precision Ion Polishing System (PIPS II)
- Instron Tukon 2100B Indenter



JEOL 2100F TEM



FEI Dual Beam FIB



GATAN PIPS II Ion Milling
System



Leica TIC 3X Masked Ion
Milling System

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Expertise in TEM analysis of ceramic materials.
- Access to an aberration corrected TEM.
- Modeling of material behavior.