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Advanced Metals and Ceramics for Armor and Anti-Armor Applications

High-Fidelity Design and Processing of Advanced Armor Ceramics

by D. E. Niesz and J. W. McCauley

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14. ABSTRACT
This is the final summary report of a 5-year (2001–2005) collaborative research program on advanced metals and ceramics for armor and anti-armor applications carried out in the U.S. Army Research Laboratory Material Center of Excellence at Rutgers and Johns Hopkins Universities under a cooperative-agreement contractual relationship. The focus of this center is on high-fidelity design and processing of advanced armor ceramics. The overarching goal has been to develop an improved understanding of selected key areas of the materials and processing science of ceramic armor materials. The areas investigated were selected jointly by the participating organizations with significant input from the ceramic armor community through a ceramic armor working group (CAWG) that included over 20 industrial organizations. They were selected as the most relevant, unclassified basic-research areas for improving the scientific understanding of the materials and processing science critical to the ballistic performance of ceramic armor materials. Length scales from the atomic to the macro were included in the investigation. The areas that were selected for investigation included the following: (1) development of nanograin-size ceramic materials to investigate their response in ballistic impact, (2) investigation of high strain-rate behavior of ceramic armor materials, (3) investigation of designed macrostructures for shock-wave management, (4) statistical analysis of inclusions in silicon-carbide (SiC) armor ceramics, (5) micromechanical modeling of advanced armor ceramics—focus on plastic behavior of polycrystalline nanograined ceramics, (6) development of improved SiC microstructures through advanced powder processing, (7) nondestructive evaluation of ceramic armor, (8) investigation of the relation between quasi-static properties and ballistic performance, and (9) evaluation of the effect of grain texturing on the ballistic performance of B_4C. Areas 7, 8, and 9 were jointly funded by the CAWG.

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