

EFFECT OF ZIRCONIUM DIOXIDE ON THE CRACK RESISTANCE OF ARMOR ELEMENTS

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During the operation of armor elements, especially under the impact of high-velocity projectiles, materials experience intensive shock loads that lead to the formation of microcracks [1-3]. These cracks can rapidly propagate and reduce the overall effectiveness of the protective system. One of the key tasks in the development of modern armor materials is to minimize the formation and spread of cracks, which directly affects the durability and effectiveness of armor protection.

The aim of this study is to determine the impact of yttrium-stabilized zirconium dioxide (ZrO_2) on the material's microstructure and its crack resistance.

The addition of yttrium-stabilized zirconium dioxide (Y_2O_3) effectively improves the mechanical properties of ceramic materials. Stabilized ZrO_2 contributes to the formation of a fine-dispersed crystalline structure with an even distribution of crystals, providing volumetric strengthening and reducing microstresses – the primary cause of crack formation during impact.

This modification increases crack resistance up to $8.1 \text{ MPa}\cdot\text{m}^{0.5}$ and maintains a high Young's modulus ($\sim 320 \text{ GPa}$), ensuring efficient energy dissipation and reducing local damage. The material demonstrates stability across a wide temperature range, which is critical for combat conditions.

The uniformly distributed structure minimizes the risk of large-scale cracking and can withstand multiple impacts while retaining its protective properties. This material is an effective component in multi-layer armor systems, combining high crack resistance with comprehensive protection.

Thus, the use of stabilized ZrO_2 significantly improves the microstructure, durability, and reliability of armor elements that meet the requirements of protection class 6.

Based on this, the use of stabilized ZrO_2 is a promising direction in the development of lightweight armor systems that offer a high level of protection with reduced weight and cost.

References:

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