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Utilizing Stabilized ZrO₂ In Armor Applications

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Abstract:

Advanced technology efforts towards the development and processing of light weight armor material fitted for personnel protection lead to toughened ceramic materials. Zirconia Toughened Alumina (ZTA) (Al₂O₃ 5 % wt. Y-PSZ reinforced with 10 % wt. of SiC particulates) ceramic matrix composite has been characterized with respect to its densification, room temperature mechanical properties, phase composition and microstructure. It was found that the composite could be densified at a temperature as low as 1575 °C by liquid phase sintering. A bending strength of 120 MPa was obtained for 75 % wt. Al₂O₃, 10 % wt. ZrO₂, 10 % wt. SiC, 5% wt. Y₂O₃ and 1% add on weight MgO composite. Lower sintering temperature was beneficial to the retention of tetragonal ZrO₂ phase at room temperature. The results indicate that liquid phase sintering has a potential advantage in the fabrication cost and room temperature mechanical properties. A complete protection against 7.62x39 AP (armor piercing projectile) with muzzle velocity 750 m/sec was achieved using the above composite with area density 48 kg/m², this area density enable this composite to replace armored steel in both personnel and light armored vehicles.