DYNAMIC BEHAVIOUR OF CERAMIC MATERIALS UNDER HIGH PRESSURE PLANAR SHOCK LOADING

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ABSTRACT

Boron Carbide (B_4C) and Zirconia toughened alumina (ZTA) ceramics exhibit better mechanical properties such as wear, corrosion resistance, high hardness and high compressive strength when compared to metallic and other ceramic materials. These ceramic materials have been widely used in specific armour applications for body armour and vehicle armour etc. In these applications the ceramic material is used to break the projectile and to reduce the impact on backing plate. Therefore the shock properties and development of equation of state of B_4C and ZTA is essential for modelling and simulation. The equation of state and shock properties of the materials are generated using a technique called plate impact in which a planar shock wave is generated and propagated through the material. The properties of the planar shock wave are determined using sensors like self shorting pins and high pressure manganin gauges.

In the present study, the material is shock loaded using an explosive driven plate impact system where the flyer plate is driven by a high explosive. The thickness of high explosive pad is varied and corresponding flyer velocities are recorded. These velocities are in the range of 1 km/s to 3.5 km/s. Similarly the shock velocities are determined using embedded self shorting pins in the target and corresponding particle velocities and hugoniot pressures are calculated using R-H equations. The experiments were performed in the high pressure regime of 20 to 80 GPa pressures. A polynomial equation of state of ZTA and B_4C ceramics has been generated. The equation of state constants for ZTA are K_1 =32348 GPa, K_2 = -265960 GPa, K_3 = 549071 GPa and for B_4C are K_1 =376 GPa, K_2 = -746 GPa and K_3 =3707 GPa. The pressure and specific volume of these two materials are compared with those of other ceramics and it is found that the specific volume of ZTA remains almost constant with increasing pressure where as for B_4C the specific volume decreases with increase of pressure.