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SHOCK WAVES GENERATED BY LASER INITIATED EXPLOSIVE FILMS

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Various research and industrial applications of explosive energy require detonation and shock waves forming a definite shape. Sometimes plane waves are necessary for initiating surfaces of explosive charges or loading on the surfaces of construction materials. For this purpose generators of plane shock waves can be used. These generators consist of two explosives with different detonation velocities[1]. Another method which uses impact to metallic plates could be suggested for a planar initiation of explosive charges[1].

Unfortunately, these methods depend on complicate research and experimental equipment and are not suitable for loading on large areas. In order to generate spherical and cylindrical detonation waves, many closely-related problems should be solved. To overcome these difficulties, we propose a secure method for producing shock wave of a definite shape without using detonator.

we used laser ignition of light sensitive explosives which covered the surface of construction materials to be loaded or charges of high explosives as the method of detonation initiation. The shape of the detonation wave is conditioned by the form of the light-sensitive explosive film. Usually, laser initiation of explosive is carried out at a distance which does not influence on the result of initiation.

The light-sensitive explosive was prepared from the complex of mercury perchlorate with 5-hydrazinotetrazole (90 mass. %) and optically transparent polymer (10 mass. %), called explosive composition EC2. The explosive films were formed by evaporating the suspension of the dust-like complex in a polymer solution[2]. EC2 explosive was initiated by Nd-laser beam[3]. Experiments show that the film sensitivity to the laser beam is 15～20 times higher than that of pressed primary explosive charges such as lead or silver azides and lead styphnate[2].

Three-layered materials were loaded by the explosion products of the light-sensitive explosive film. The first and second layers of the target are polymer composite materials and the third is aluminium plate. A polymeric glue with polymerization temperature near 250°C bonds the layers of the laminate. The target diameter is near 50mm. The laser beam diameter is 70mm. The surface of the target outer layer is covered by the

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EC2 explosive film of 0.5mm thickness. The mean surface radiation energy is about 1.5 times higher than the initiation threshold of EC2 explosive film. The sample was posed at the center of the laser beam to initiate the plane detonation wave over the whole surface. The first polymer layer came off the target without destruction as a result of the shock, rarefaction and reflection shock waves interaction (Fig. 1). The circular crack in the second polymer layer was formed (Fig. 1). The cause of this effect is the interaction of the above waves. A different picture appeared because of the circular detonation wave directed to the center of the sample (Fig. 2). Such wave configuration was obtained when a circle patch of black paper with 48mm diameter covered on the center of the sample. The first polymer layer came off the target and was destroyed near the border. Interaction of rarefaction waves caused rupture along the contact surface of the second and third layer. Three beam cracks at the center of the first polymer layer were resulted from energy cumulation effects (Fig. 2). A few circular and radial cracks were formed at the surface of the first layer upon laser irradiation of a 4mm-spot at the sample center (Fig. 3). Irradiation of a 10mm segment resulted in a linear detonation wave. The wave progress caused rupture of the material on the periphery and in the central part of the sample (Fig. 4).

Thus, laser initiation of light-sensitive explosive film is a simple method to design different shapes of detonation waves.

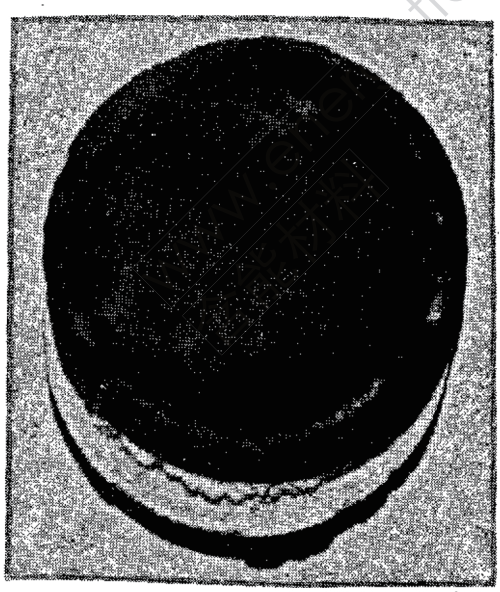

Fig. 1 The plane loading of the whole surface of the sample

Fig. 2 Irradiation of the ring

Fig. 3　Irradiation of the central spot

Fig. 4　Irradiation of the segment

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LITERATURE

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