A new formula for predicting the crater size of a target plate produced by hypervelocity impact

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Abstract

Hypervelocity impact (HVI) of materials is usually associated with large deformations of structures, big craters, phase transition of materials and scattered debris cloud. It is difficult to predict the size of damage caused by HVI while comprehensively considering all the influencing factors for both experimental and numerical approaches. In this paper, the hypervelocity impact process is modeled using a Smoothed Particle Hydrodynamics (SPH) [1, 2] method with Kernel Gradient Correction (KGC) technique. The SPH method with KGC has been demonstrated in modeling HVI problems to have better accuracy and reliability [3]. The SPH method is used to investigate the hypervelocity impact of a sphere on a target plate. The size of the crater produced by HVI at different impact velocities is obtained, and the varying pattern of the crater size vs impact velocity is studied. According to the present simulation results, a critical velocity is identified and the increase of the crater size vs impact velocity can be divided into two stages, the growth stage and stable stage. A new analytical formula is presented for predicting the crater size on the target plate produced by HVI. This formula comprehensively considers the effect of different factors, such as the densities of two materials, the sound speed of the target material, the diameter of the projectile and the thickness of the target plate. The results calculated by the new prediction formula agree well with experimental observations, and with the present SPH simulation results.

Keywords: Hypervelocity impact, Smoothed particle hydrodynamics (SPH), Kernel gradient correction, Critical velocity, Crater size prediction formula

Reference:

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