On the Response of Solids, Powders, and Powder Mixtures to Shock-wave Loading

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Introduction

- **The study of the response of solids, powders, and powder mixtures to shock-wave loading, has added significantly to our understanding of physical processes which take place at high pressures, high temperatures and very short times**

- **The response contains valuable information about the thermophysical properties of solids and disperse media**

- **One particular aspect of these studies is to determine the equation of state for different materials from shock-wave experiments**

Main results

- **Solids**
  - **Complete equation of state for solids, expresses in term of the material constants and the parameters of the shock Hugoniot**
  - **Expression for the temperature of the shock Hugoniot of a solid**

- **Powders and powder mixtures**
  - **The shock Hugoniot of a single component monodisperse system in which porosity appears as a parameter**
  - **Inverse shock Hugoniot (the shock volume expresses as a function of pressure)**
  - **The inverse shock Hugoniot of a two component monodisperse powder mixture**

Inverse Shock Hugoniot

Single component system :

Shock Hugoniot in variables P and V

$$P_H = \frac{(V_0 - V)c_0^2}{[V_0 - s(V_0 - V)]^2}$$

Inverse shock Hugoniot

$$V_H = V_0 \exp\left[\frac{1-(1+\beta P_H / B_0)^{1-x}}{\beta(1-x)}\right]$$

Multicomponent system

$$V_H = \sum_{i=1}^{n} \alpha_i V_{Hi}$$

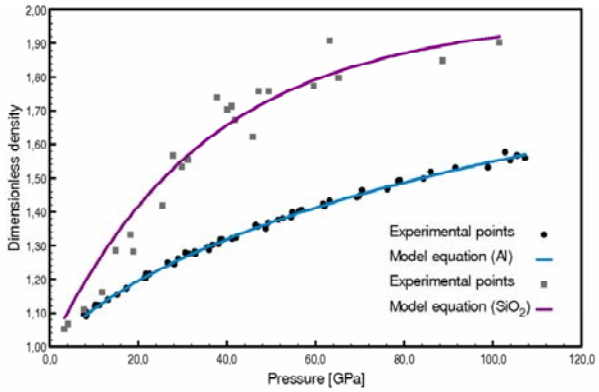
Two-component system $Al - SiO_2$

$$V_H = \alpha_{Al} V_{H,Al} + \alpha_{SiO_2} V_{H,SiO_2}$$

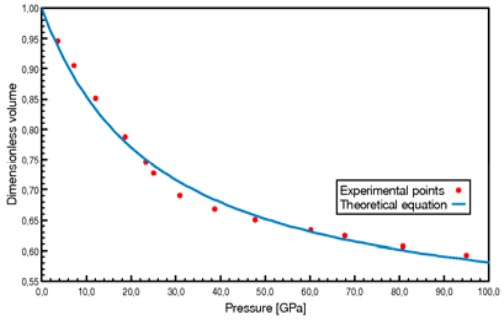
Examples

Experimental points and inverse shock Hugoniots for Al and SiO_2

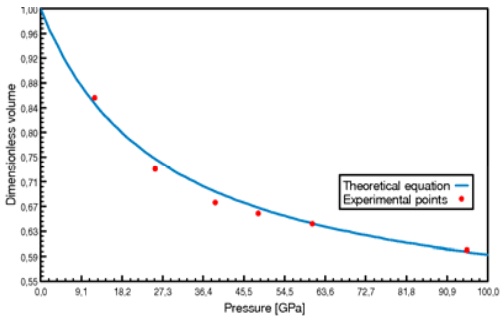
Single component systems : Al and SiO_2



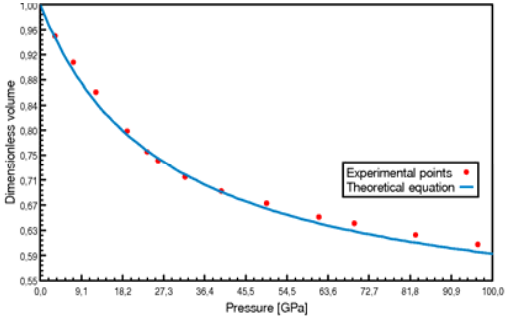
Multicomponent system : aluminum – quartz



aluminum – quartz: wt% SiO_2(50) Al(50)



aluminum – quartz: wt% SiO_2(40) Al(60)



aluminum – quartz: wt% SiO_2(30) Al(70)