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Building of Equations of State with Numerous Phase Transitions — Application to Bismuth OLIVIER HEUZE, CEA/DIF, B.P. 12 , 91680 Bruyeres-Le Châ CEDEX, France — Modelling of shock waves crossing material with several phase transitions requires the knowledge of the equation of state (E.o.S.) of the material and its thermodynamic properties. The phase transitions correspond to volume and entropy jumps and discontinuities of extensive properties of the different phases. Building a complete E.o.S. with numerous crystallographic phase transitions raises many issues. It is generally a function of volume and temperature although thermodynamic equilibrium is defined for given temperature and pressure. Experimental data are generally available only in the (P,T) plane. Only few experimental data exist about the volume jump and none for the entropy jump. We propose an algorithm to build complete E.o.S. including several solid/solid or solid/liquid phase transitions. Each phase has its own E.o.S. and independent parameters. The phase diagram is calculated from the Gibbs free energy minimum. The phase transition is calculated from the Gibbs free energy equality between two phases which provides the thermodynamic properties of their binary mixture, and volume and entropy jumps. We explain how to determine these jumps in accordance to thermodynamic rules and experimental data. Until now, such an approach was used in simple cases and limited to 2 or 3 phases. We have applied it in the general case to bismuth for which up to 11 phases have been identified. This study show the great influence of binary mixtures and triple points properties in released isentropes after shock waves.

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