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A Study In Mechanochemistry: Pressure Induced Reactions, Nonequilibrium Phenomena

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ABSTRACT

This paper describes some aspects of mechano-chemical reactions performed in a Bridgman anvil. The formation of fracture products, that was reported earlier [1,2], indicates that events occur on a time scale that would not be long enough to establish equilibrium. Although intense collisions occur, many particles are ejected at high kinetic energy from the press with the bulk of its energy focused in translational energy along the radial degree of freedom. A phenomenological model of the fracture/reaction zone is presented. Emphasis is placed on time scales of consecutive processes, thickness of the reaction zone. The problem of non-equilibrium is under consideration. Nonequilibrium presents on two levels: within an atom it is the excitation of electrons from their ground state, whereas nonequilibrium of a collection of atoms is marked by a deviation from a Maxwellian equilibrium. The longevity of any non-equilibrium state depends on the competition between time scales of energy transfer to different forms; the intensity of the nonequilibrium state reflects the magnitude of such a transfer. It is expected that the bulk of the chemical energy ends up as translational kinetic energy with little thermalization. Distributions along different degrees of freedom are not expected to be in equilibrium. The equilibrium would only be established through sufficient collisions. The second part of the paper is a study of the relaxation of the ejected particle stream.

Keywords: ***Bridgman anvil, non-equilibrium phenomena, powder compression, blast.***