DETONATION TEMPERATURE AND SOOT OF SLURRY EXPLOSIVES

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For the calculations, in which the first set of decomposition gases is assumed, predicted heats of detonation of slurry explosives with the product H_2O in the gas phase have a deviation of 866 kJ/kg from the results with the product H_2O in the liquid state. Fine-particle lithium manganate has been prepared by the detonation of slurry explosives of the metal nitrates, $M(NO_3)_x$ (M = Li, Mn) as oxidizers and glycol as fuels at high temperature and short reaction time. The detonation products are identified from X-ray powder diffraction (XRD) patterns, and scanning electron microscopy (SEM) measurements. The XRD analysis shows that nanoparticles of Lithium Manganate can be produced from detonation of slurry explosives due to fast quenching as well as appropriate detonation velocity, pressure and temperature.

We will demonstrate the method of calculating the detonation heat, except we will use the predicted heats of formation of the reactants and products rather than the measured values. The method will be applied to special slurry explosives for the formation spinel Lithium Manganates.

Water-gel or slurry explosives developed in the late 1950s became quite widespread in their use from the mid 1960s [1]. Mohammad Hossein Keshavarz [6] introduced a simple procedure by which the detonation pressure of CaHbNcOd explosives can be predicted from a, b, c, and d.

The detonation heat, Q, defined as the negative of the enthalpy change of the detonation reaction, is the energy available to do mechanical work and has been used to estimate detonation parameters. This quantity can be determined from the heats of formation of the reactants and the products of the detonation through the relation [2]

$$Q_v = \sum n_i C_{vi} T \quad \text{or} \quad Q_v = \sum n_i C_{vi} t \,,$$

where T (k) and t (^{o}) are the detonation temperatures.

$$C_{vi} = a + bt \,,$$

$$Q_v = (a + bt)t \,,$$

$$t = \frac{-a + \sqrt{a^2 + 4bQ_v}}{2b} \,.$$

For the double atoms in the gas phase [9], $C_v = 20.10 + 1.88\times10^{-3}\,t$.

For H_2O, $C_v = 16.72 + 8.99\times10^{-3}\,t$.

For CO_2, $C_v = 37.62 + 2.42\times10^{-3}\,t$.

For crystals [10], $C_v = 3R = 24.94$ (It's Dulong-Petit's law).

Detonation wave synthesized Lithium Manganate is found to be a polycrystalline powder. Most of the particles have a round shape, which ensures they can be used as an ideal active material. Fig. 1 shows a SEM image of polycrystalline Lithium Manganate particles with a size of 0.1-2 μm, in which small crystallites can be observed. The particle size distribution analysis shows that detonation synthesized Lithium Manganate has a particle size range 0.1–2 μm.

The calculated mean grain sizes are 6.47 nm for detonation synthesized Lithium Manganate. Here the mean grain size for detonation synthesized Lithium Manganate refers to the mean size of crystallites of polycrystalline particles.

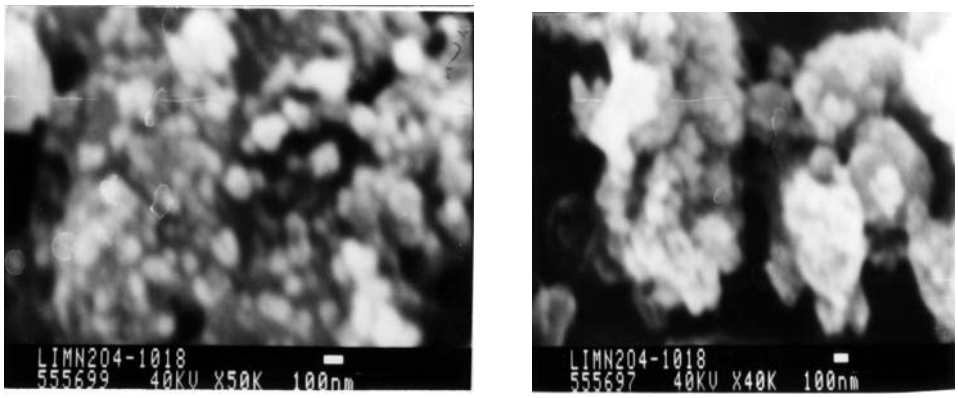

Fig. 1. SEM image of detonation synthesized Lithium Manganates

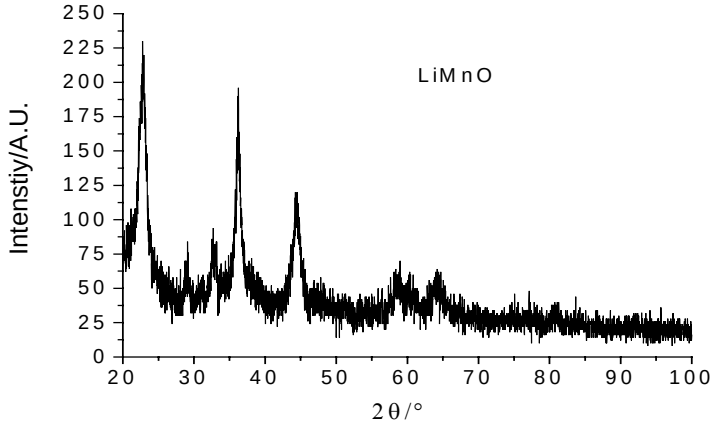

Fig. 2. XRD patterns of detonation synthesized Lithium Manganate

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