The Effect of High Energy Milling on the Solid State Synthesis of MnFe$_2$O$_4$ from Mixtures of MnO–Fe$_2$O$_3$ and Mn$_3$O$_4$–Fe$_2$O$_3$

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A thermal treatment at 900 °C (under nitrogen) of a milled mixture MnO–Fe$_2$O$_3$ yields MnFe$_2$O$_4$ mainly as the product of the reaction between Mn$_3$O$_4$ (produced by ball milling) and Fe$_2$O$_3$. Under the same experimental conditions but starting from an unmilled MnO–Fe$_2$O$_3$ mixture, the formation of MnFe$_2$O$_4$ is only partial and occurs through Mn$_3$O$_4$ (formed by oxidation of MnO). The same thermal treatment (900 °C under nitrogen) of a milled Mn$_3$O$_4$–Fe$_2$O$_3$ mixture yields MnFe$_2$O$_4$ mainly as the product of the reaction between Mn$_3$O$_4$ and Mn$_2$O$_3$/MnO$_2$ (the higher Mn oxides being produced by ball milling) and Fe$_2$O$_3$. The effect of high energy milling is more pronounced in the case of the Mn$_3$O$_4$–Fe$_2$O$_3$ system since no MnFe$_2$O$_4$ formation is observed when starting from a physical mixture.

Key words: Mechanical Activation, Manganese Ferrite, Thermogravimetric Analysis