Phase Transformation of Ferrites by Gas-Solid Combustion Synthesis

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The mechanism of formation of hard magnetic hexaferrites: $\text{BaFe}_{12}\text{O}_{19}$, $\text{SrFe}_{12}\text{O}_{19}$, $\text{PbFe}_{12}\text{O}_{19}$, and cobalt monoferrite $\text{CoFe}_2\text{O}_4$, and soft magnetic ferrites: $\text{Ni}_{0.35}\text{Zn}_{0.65}\text{Fe}_2\text{O}_4$, $\text{Mn}_{0.73}\text{Zn}_{0.27}\text{Fe}_2\text{O}_4$, during gas-solid combustion synthesis was investigated. A combination of several investigation techniques, including quenching of the combustion front, X-ray diffraction, and thermal and magnetic analyses, was used to determine the sequence of phase transformations during synthesis. The combustion synthesis of different ferrites is a multistage process and involves several intermediate products, such as $\text{FeO}$, $\text{Fe}_3\text{O}_4$, $\text{ZnFe}_2\text{O}_4$, $\text{BaFe}_2\text{O}_4$ or $\text{Sr}_7\text{Fe}_{10}\text{O}_{22}$, and $\text{PbFe}_4\text{O}_7$. The formation of target final composition usually starts in postcombustion zones, and their conversion degree and properties strongly depend on the cooling rate.