THERMAL DECOMPOSITION OF BARIUM FERRATE(VI) IN AIR

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Thermal decomposition of barium ferrate(VI) ($BaFeO_4$) in static air was investigated using ^{57}Fe Mössbauer spectroscopy, X-ray powder diffraction (XRD), thermal analysis and microscopic techniques (TEM, SEM). $BaFeO_3$ was confirmed to be the primary decomposition product above 190 °C. $BaFeO_3$ was found to be unstable in air at high and/or room temperature reacting with air-CO_2 towards orthorhombic $BaCO_3$ and speromagnetic amorphous Fe_2O_3 nanoparticles (< 5 nm). The room temperature Mössbauer spectrum of the product of decomposition at 300 °C consists of two components. A singlet (δ_{Fe} = –0.27 mm/s) corresponds to tetravalent iron atoms in rhombohedral $BaFeO_3$ structure, while a doublet (δ_{Fe} = 0.35 mm/s, ΔE_Q = 0.56 mm/s) was ascribed to amorphous Fe_2O_3. At 600 °C, the solid state reaction between the as-formed Fe_2O_3 and $BaCO_3$ towards barium ferrite ($BaFe_2O_4$) nanoparticles (20-100 nm), takes place. The overall decomposition mechanism of $BaFeO_4$ in air can be described by the following chemical equations:

300 °C:

$$BaFeO_4 \rightarrow BaFeO_3 + 1/2\ O_2$$

$$BaFeO_3 + CO_2 \rightarrow BaCO_3 + 1/2\ Fe_2O_3 + 1/4\ O_2$$

600 °C:

$$Fe_2O_3 + BaCO_3 \rightarrow BaFe_2O_4 + CO_2.$$

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