POLYMORPHOUS TRANSITIONS OF NANOMETRIC Fe_2O_3 BY VIEW OF MÖSSBAUER SPECTROSCOPY

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Each of the four different known crystalline Fe_2O_3 polymorphs (alpha, beta, gamma, and epsilon-Fe_2O_3) has unique biochemical, magnetic, catalytic, and other properties that make it suitable for specific industrial applications. High temperature treatment is a key step in most syntheses of iron(III) oxides, but often induces polymorphous transformations that result in the formation of undesired mixtures of Fe_2O_3 polymorphs. On the other hand controlled polymorphous transformation can be use as a method to get given polymorph. It is therefore important to control the parameters that induce polymorphous transformations when finding routes to prepare given Fe_2O_3 polymorph as a single phase. The dependence of the mechanism and kinetics of the polymorphous transformations of Fe_2O_3 on the intrinsic properties of the material and external parameters of synthetic and/or natural conditions such as temperature, atmosphere, and pressure are discussed. In addition, the question of whether different Fe_2O_3 polymorphs are formed sequentially or simultaneously during thermal processes is discussed. ^{57}Fe Mössbauer spectroscopy presents a powerful experimental tool for unambiguous identification of each ferric oxide polymorph irrespective of particle size and crystallinity. In this context, Mössbauer spectra and their typical hyperfine parameters at various temperatures are introduced for individual Fe_2O_3 polymorphs. Finally, particular solid-state syntheses of ferric oxide based nanomaterials, they characterization and industrial applications are presented.

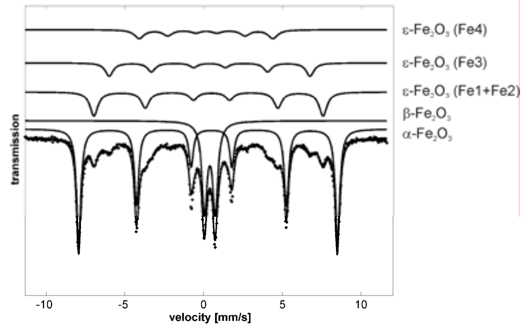

Figure 1. Mössbauer spectrum of sample, which contains α-Fe_2O_3, β-Fe_2O_3 and ε-Fe_2O_3

[1] L. Machala, J. Tuček, R. Zboril, Chem. Mater. 23(14) (2011) 3255-3272.
[2] L. Machala, R. Zboril, A. Gedanken, J. Phys. Chem. B (2007) 4003-4018.