Mössbauer Studies of Fe$^{2+}$ in Iron Langbeinites and other Crystals with Langbeinite Structure

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$^{57}$Fe Mössbauer spectra have been measured at various temperatures between 4.2 K and 300 K for iron langbeinites $A_2Fe_2(SO_4)_3$ with $A = K, NH_4$, Rb, Tl and magnesium, manganese and cadmium langbeinites doped with Fe$^{2+}$. The spectra revealed several contributions whose isomer shifts and quadrupole splittings have been obtained by fitting program routines. For the high-temperature cubic phases two crystallographically non-equivalent iron sites have been identified, characteristic of Fe$^{2+}$ in the high-spin state. Abrupt changes of the quadrupole couplings indicated phase transitions; in some cases, the spectra have also revealed several sites for Fe$^{2+}$ in low temperature phases. From the temperature dependencies, phase transition temperatures, crystal field splittings and Debye temperatures have been derived.

Key words: $^{57}$Fe Mössbauer Spectroscopy; Inorganic Crystals; Structure; Phase Transitions.

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