MÖSSBAUER STUDY OF VALENT AND STRUCTURAL STATE OF IRON IONS IN BASALT FIBER

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Different types of the industrial fiber and its raw material have been investigated by means of the Mössbauer spectroscopy. The series of samples produced by Lianozovo, Dmitrov and Sudogda plants have been studied. Samples have been chosen on the different stages of the fiber formation process. The spectra of two basalt fiber samples obtained under foreign technology have been measured in order to compare them with that of Russian fiber.

Mössbauer spectra of the samples have been measured by means of MS1101E spectrometer using constant accelerations with saw-shaped time dependence of Doppler velocity at room temperature. ^{57}Co in Rh matrix source have been used in the experiment. Typical spectra of fiber and raw material are shown on Fig.1. The spectra appear to be a superposition of the contributions of ferric and ferrous iron ions. Widening and asymmetry of the lines caused probably by glass state of the material and consequently by the existence of quazi-continious distribution of hyperfine parameters.

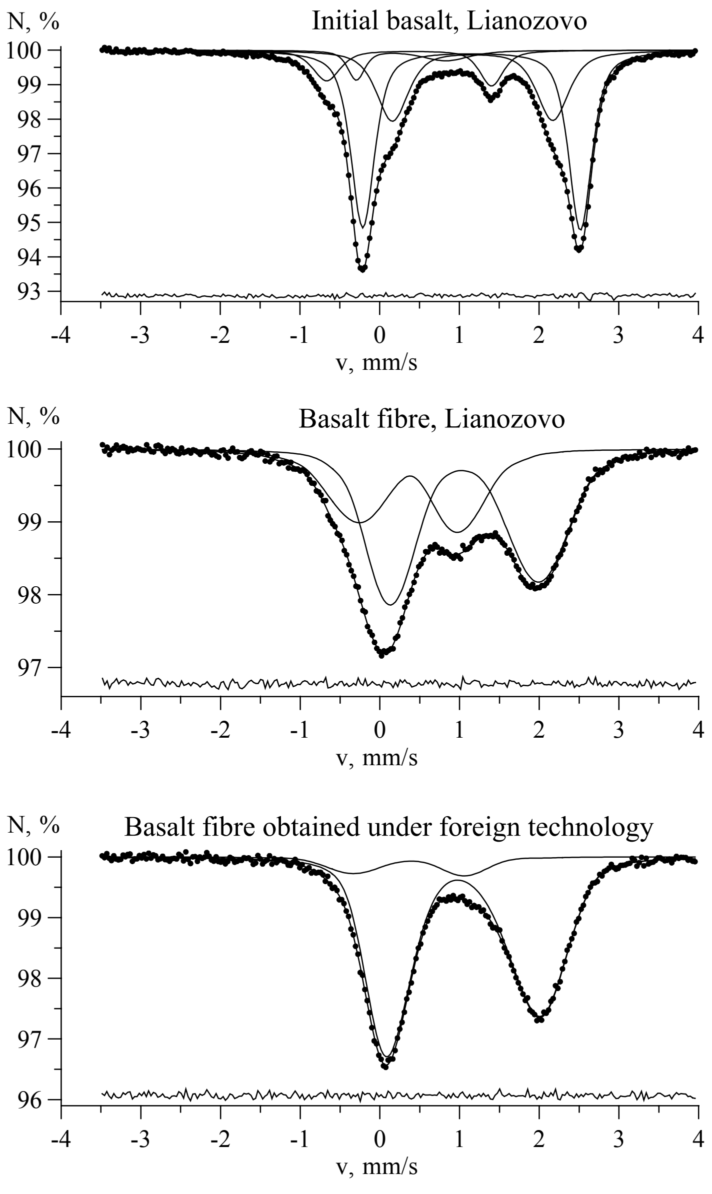

Fig. 1

Spectra of basalt fiber have been processed using MSTools software [1] by means of a reconstruction of two independent distribution functions of hyperfine parameters (Fe^{3+} and Fe^{2+}). The relative contents of ions of different valence can be estimated using the intensity of the appropriate partial spectra.

Hyperfine parameters of Mössbauer spectra and Fe^{3+}/Fe^{2+} ratio of the studied fiber have been obtained during the research.

Relative intensity of the partial spectrum of Fe^{3+} ions is shown on the Fig.2. The samples are grouped by plants and by technological stages. One can see that the significant increase of iron ions is happening during the process of fiber formation. The relative contents of Fe^{3+} ions in Russian basalt fiber is significantly higher than that in fiber obtained under foreign technology.

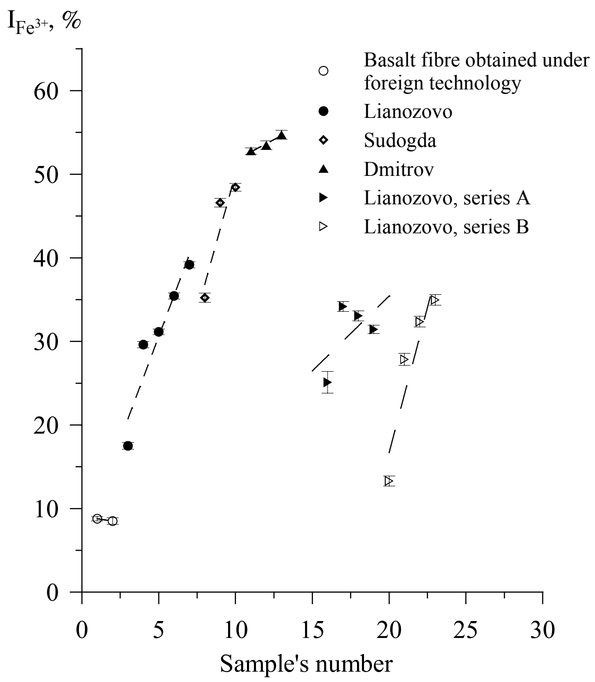

Fig. 2

In the samples produced by Dmitrov plant the values of the shifts fall into the interval typical for tetrahedral coordination.

Thus following conclusions can be made.

1. In all the studied samples Fe^{3+} ions have octahedral coordination. Fe^{2+} ions have octahedral coordination or exhibit transition from tetrahedral to octahedral coordination during the fiber formation process.

2. Significant increase (up to 20%) of Fe^{3+} ions share occurs during the formation process.

3. The contents of Fe^{3+} ions in the sample obtained under foreign technology is significantly lower (10÷45%) than that in samples of fiber and material obtained in Russia.

4. Probably the decrease of Fe^{2+} share causes the changes of physical properties of basalt melt during the technological process of fiber formation.

The value of the Mössbauer line shift corresponding to Fe^{3+} ions falls into the interval which is typical for Fe^{3+} ions in octahedral coordination (see Fig. 3). For the most of the studied samples the values of the shifts corresponding to Fe^{2+} ions are also fall into the interval which is typical for octahedral coordination. In the samples produced by the Sudogda plant the values of the shifts are changing from the typical for tetrahedral coordination to the values typical for octahedral coordination.

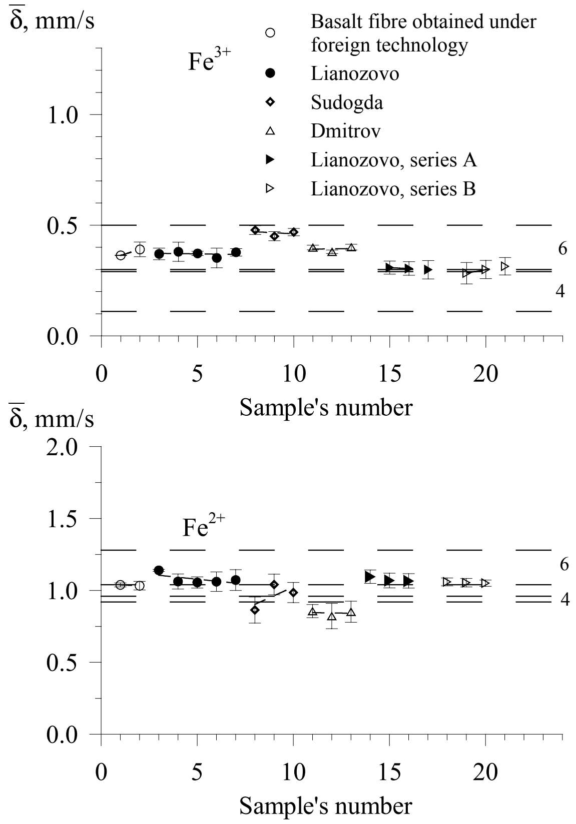

Fig.3

Reference:

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