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Effect of mechanical milling duration on the morphology of lithium ferrite powder

Lithium ferrites based on $LiFe_5O_8$ are important functional materials for modern microwave electronics. Furthermore, lithium ferrite has the highest Curie temperature of the lithium-substituted ferrites. Also it's thermally stable and attractive material for use as a microwave ferrite material. However, pure lithium ferrite without additives in practice is used rarely because the low values of the electromagnetic characteristics are determined mainly microstructure of ferrite.

The perfection of traditional methods of synthesis and elaboration of new methods for lithium ferrites were implemented realize in order to improve the quality of production. In most practical applications, it is required to produce nanostructured $LiFe_5O_8$ of homogeneous composition [1].In [2–3], mechanical activation of the initial reactants is shown to greatly increase its reactivity, and allows us obtaining the lithium ferrites at significantly lower temperatures as compared with those obtained by the conventional method.

Experimental

Lithium ferrite ($LiFe_5O_8$) samples were prepared by standard ceramic technology. Lithium carbonate (Li_2CO_3) and iron oxide (Fe_2O_3) were used as the initial reagents to product lithium ferrite with a ratio of 1:5.

Before weighing, initial powders were dried for three hours at a temperature of 200 °C in a drying oven. Synthesis of lithium ferrite was conducted at 800 °C for 120 minutes in standard laboratory oven.

The obtained powder was milled in the SPEX 8000M planetary ball mill using tungsten carbide balls. The milling time was 30, 60 and 120 minutes. After each milling stage, the particle size was analyzed by laser diffraction with Fritsch analyzer. The micrographs of non-milled powder and those for milled for 30, 60 and 120 minutes, respectively, were obtained.

Results and discussion

Fig. 1 shows the SEM micrographs for a non-milled sample A (fig. 1, *a*), milled lithium ferrite 30 min (fig. 1, *b*), 60 min (fig. 1, *c*), and 120 min (fig. 1, *d*). The average particle size was 0.59 μm for a non-milled sample. After milling, the average particle sizes were 0.57 μm in milling for 30 min, 0.54 μm in milling for 60 min, 0.42 μm in milling for 120 min.

As can be seen in fig. 1, mechanical activation of lithium ferrite powder leads to slight reduction in particle size and higher powder homogenization. Thus, to obtain a homogeneous composition of the lithium ferrite powder, the time of mechanical treatment should be at least 2 hours.

Conclusions

The results showed that mechanical activation of lithium ferrite powder in air at room temperature causes slight reduction of the particle size and increases the homogeneity of the ferrite powder.

In this case, the optimal conditions to obtain a homogeneous composition of the lithium ferrite powder are:

1. mechanical activation in SPEX 8000M planetary ball mill;
2. at least 2 hour milling duration.

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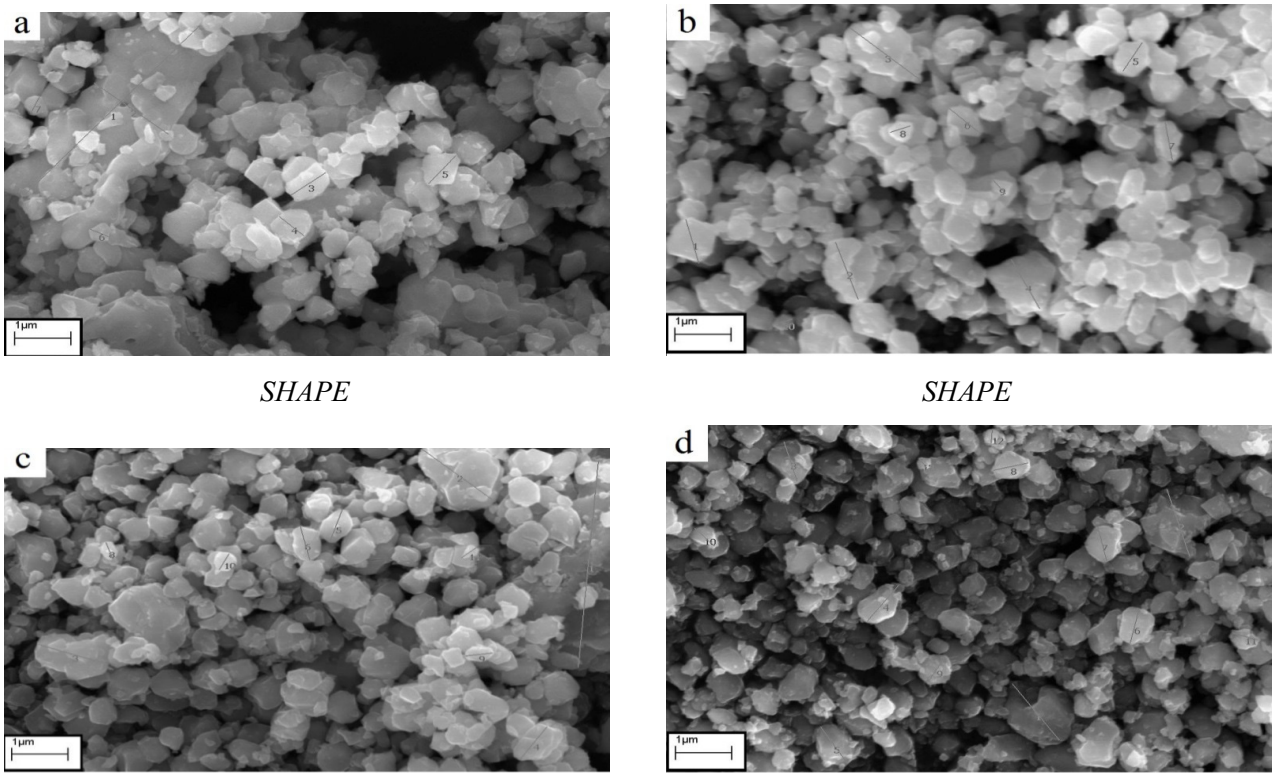

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Fig. 1. SEM micrographs for non-milled sample (a), milled for 30 min (b), 60 min (c), and 120 min (d)

References

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