A 8-a ediție a Seminarului Național de Nanoştiință şi Nanotehnologie
Academia Română, 27 aprilie 2009

NONCONVENTIONAL METHOD FOR SYNTHESIS OF COBALT-FERRITE NANOPOWDER

Rodica-Mariana ION, Dragoş Viorel BREZOI – VALAHIA Universitaty of Târgovişte

The purpose of our study was the incorporation hydrazine together with metallic cations in the structure of some oxalates for yielding coordination compounds, chemical precursors for low temperature synthesis of cobalt-ferrite nanopowder.

experimental

► obtaining

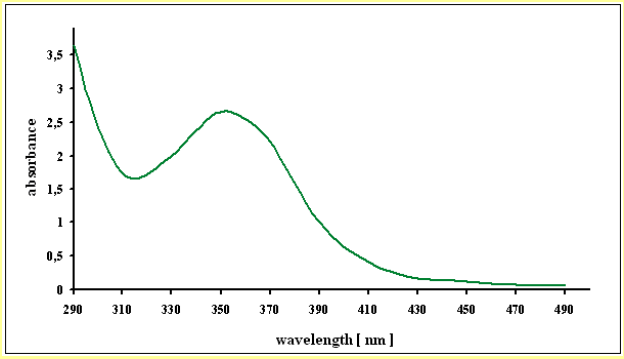
Ammonium oxalate and a solution of hydrazine hydrate (1:3 molar ratio) were mixed and stirred under a nitrogen atmosphere at 80 °C for one hour to provide ammonium oxalate hydrazinate. A saturated mixture of cobalt and ferrous chloride solutions (1:2 molar ratio) was added slowly to the ammonium oxalate hydrazinate complex in a 1:1 molar ratio to obtain a precipitate of cobalt and ferrous oxalate hydrazinate complex. The precipitate was washed, filtered, and dried at 70 °C to avoid the thermal decomposition. Heated in air at 260 °C, the precursor decomposes exothermic producing a fine, crystalline powder of oxide ceramic material. This material was analyzed after a thermal treatment at 500 °C, in air, for one hour. The product has the chemical formula $CoFe_2O_4$.

► results and discussions

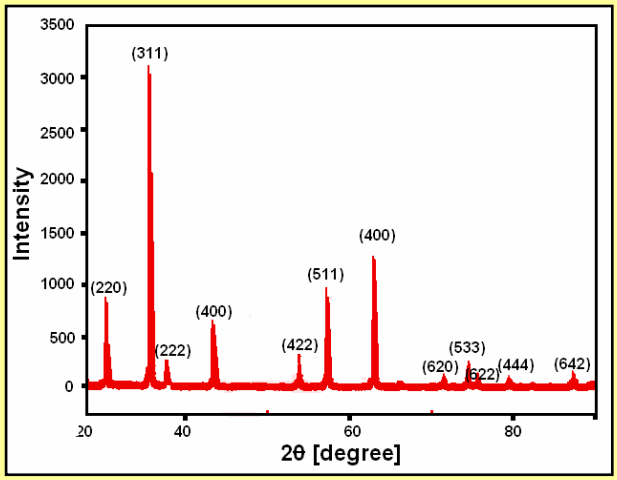
Chemical analyses confirm the molar ratio Co:Fe = 1:2 in ferrite powder. The content of Co and Fe (%) in the obtained powder is comparable with the content of Co and Fe in $CoFe_2O_4$.

Analized	*Co*	*Fe*
Content (%)	25.2	47.2

The ***UV-Vis*** absorption spectrum shows that the ferrite powder is identified by the charge transfer band at λ = 350 nm.



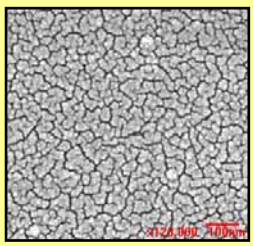
The ***XRD*** indicated a pure nanocristaline cobalt ferrite, with the grain size in the range 20–30 nm.



Mössbauer data confirmed that the appearance at 500 °C a partial inverse spinelic structure appears:
$[Co^{2+}_{0.57}Fe^{3+}_{0.43}]_{tetra}[Co^{2+}_{0.43}Fe^{3+}_{1.57}]_{octa}O^{2-}_4$
The Mössbauer parameters show that we have obtained the monophasic powder with magnetic properties.

Coordination	IS (mm/s)	QS (mm/s)	H_{eff} (kOe)	G (%)
Fe^{3+} tetrahedral	0.24	0	484	41.6
Fe^{3+} octahedral	0.36	0	512	30.7
			496	14.8
			478	14.8
			442	14.8

SEM image of Co–ferrite nanograins deposited on Si substrates. Most $CoFe_2O_4$ nanoparticles are well crystallized. $CoFe_2O_4$ particle size falls in the size range 20–30 nm.



◄ *The SEM image of $CoFe_2O_4$ powder obtained deposited on substrate (×120000)*

conclusions

The preparation of ultra fine cobalt ferrite powder by a wet chemical method and characterization by XRD, UV/Vis, Mossbauer spectroscopies, and SEM are discussed in this paper. The analyses show the presence of a homogenous compound with characteristic properties and well crystallized spinel structure, with formula $CoFe_2O_4$.

Acknowledgments: this work has been supported by National Excellence Programs PN2-22-110