Structure analysis of cobalt ferrite/titania-silica composite

Structure Analysis of cobalt ferrite / titania-silica composites

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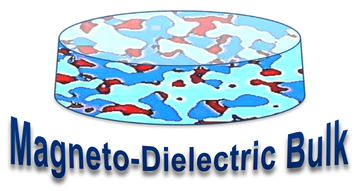
ABSTRACT

Magnetodielectric bulk composites of a magnetic phase in dielectric matrix have been prepared. Silica glass and titania electrocoagulated powders have been used as dielectric phases and cobalt ferrite powder as magnetic one. This study aims at tailoring the magnetic and dielectric phases and their interfaces in order to tune new electromagnetic properties. The microstructure of sintered titania-silica/cobalt ferrite composites has been related to compositional modifications in terms of silica/titania weight ratio and titania-silica/cobalt ferrite volume ratio. The crystalline structure was studied through the comparison of the XRD patterns with the EDS analysis and the results of the image analysis done on the SEM micrographs.

Objectives

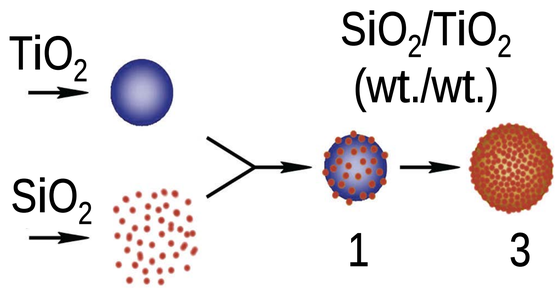
- Increase the cobalt ferrite amount after reactive sintering in $TiO_2/CoFe_2O_4$ ceramic compounds [1]



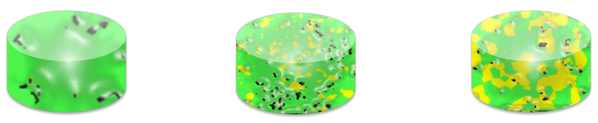
Materials & Methods

SiO_2 coatings over TiO_2 particles have been selected, owing to its high chemical stability [2].

HETERO-COAGULATION [3,4]



FORMING



SiO_2/TiO_2 (wt./wt.) →	0:1	1:1	3:1
$CoFe_2O_4$ (wt.%) →	80	80	80

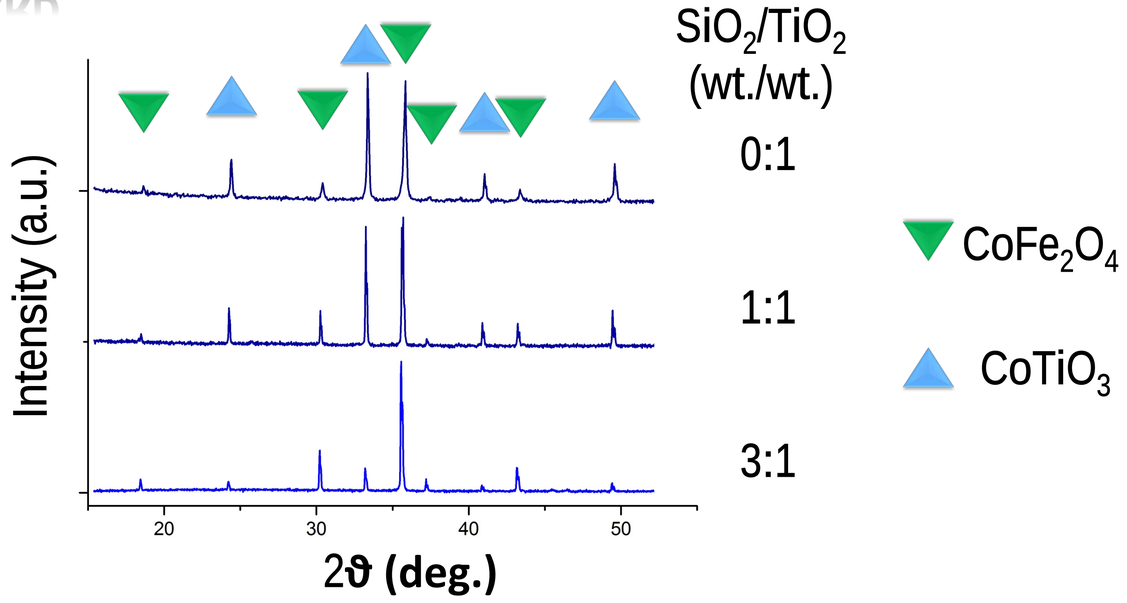
SiO_2/TiO_2 wt./wt. [g/g]	$CoFe_2O_4$ [vol. %]	TiO_2 [vol. %]	SiO_2 [vol. %]
0	74.94	25.06	0
1	68.11	11.39	20.50
3	65.14	5.45	29.41

SINTERING 1200 °C X 2 h

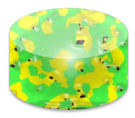
Th. Density [g/cm³]	Density [g/cm³]	$CoFe_2O_4$ [vol. %]	TiO_2 [vol. %]	SiO_2 [vol. %]	Fe_2O_3 [vol. %]	$CoTiO_3$ [vol %]
5.61	90.8%	20.67	0	0	39.16	40.17
4.59	98.8%	43.84	0	20.85	17.43	17.88
4.35	98.9%	53.62	0	29.65	8.26	8.47

Results

XRD

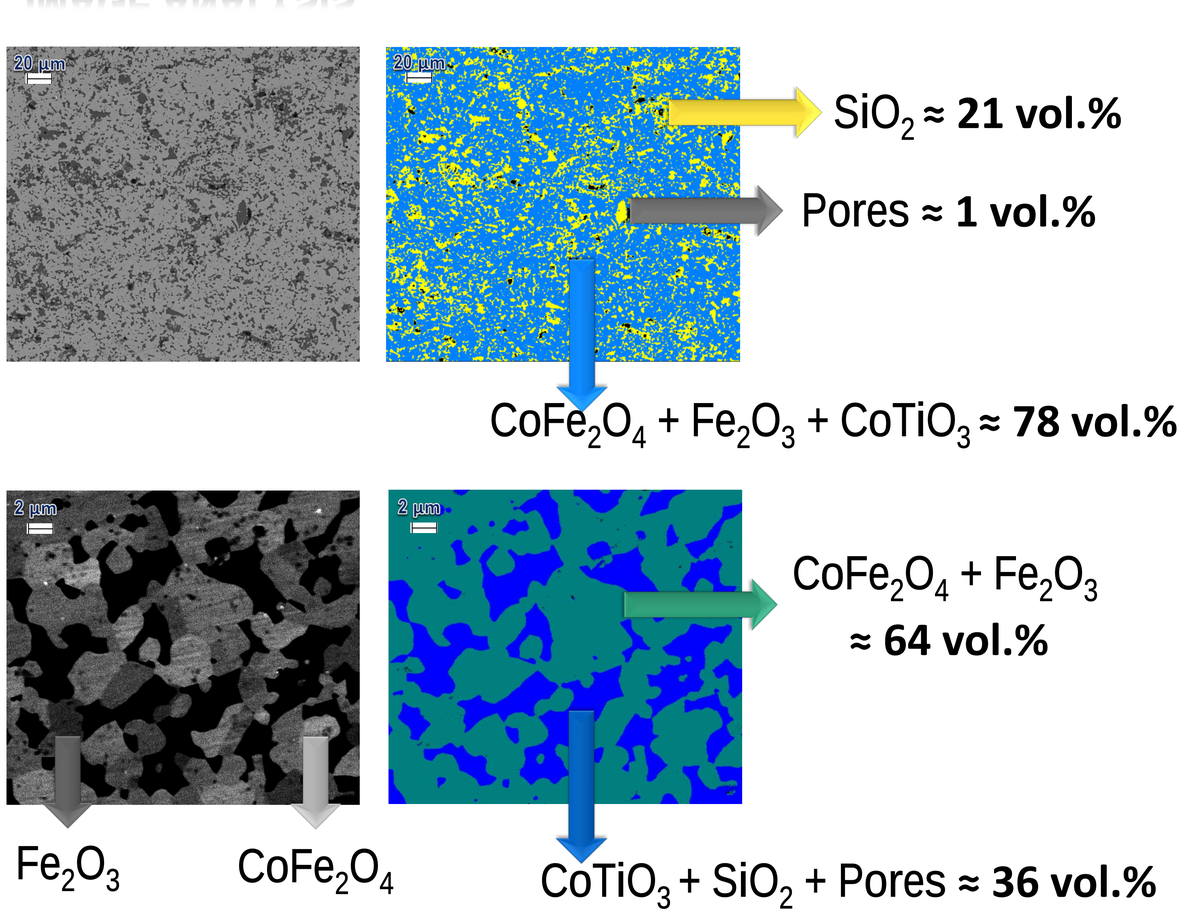


THEORETICAL



3:1	Density [g/cm³]	$CoFe_2O_4$ [vol. %]	TiO_2 [vol. %]	SiO_2 [vol. %]	Fe_2O_3 [vol. %]	$CoTiO_3$ [vol %]
	98.9%	53.62	0	29.65	8.26	8.47

IMAGE ANALYSIS



Conclusions

- SiO_2 coatings over TiO_2 particles did not avoid the reaction sintering in $TiO_2/CoFe_2O_4$ ceramic compounds.
- SiO_2 amount increases the volume percentage of unreacted $CoFe_2O_4$ in the sintered samples

References

[1] M. Coskun, et al. J Nanopart Res, 14, 1197, 1 - 9 (2012).
[2] H. Yang, et al. App. Phys Lett, 94, 013103 - 013103-3 (2009).
[3] H. C. Hamaker, Physica IV, 10, 1058 - 72 (1937).
[4] R. Hogg et al., Trans. Faraday Soc. 62,1638 - 1651 (1996).

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