

Structure analysis of cobalt ferrite/titania composites

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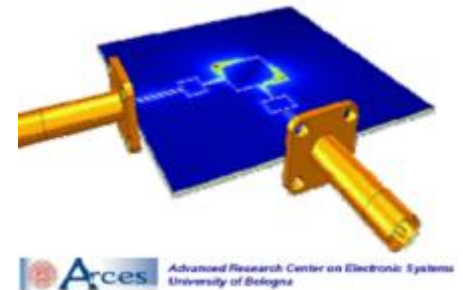


□ Main Application Area:

➤ Miniaturized Microstrip Antennas

- for wearable and wireless applications in the **UltraHigh Frequency**

UHF → 300 MHz ÷ 3 GHz



[] Martino Aldrigo, Alessandra Costanzo, Diego Masotti, Carmen Galassi. Exploitation of a novel magneto-dielectric substrate for miniaturization of wearable UHF antennas. *Materials Letters*. Vol. 87: 127-130, 2012

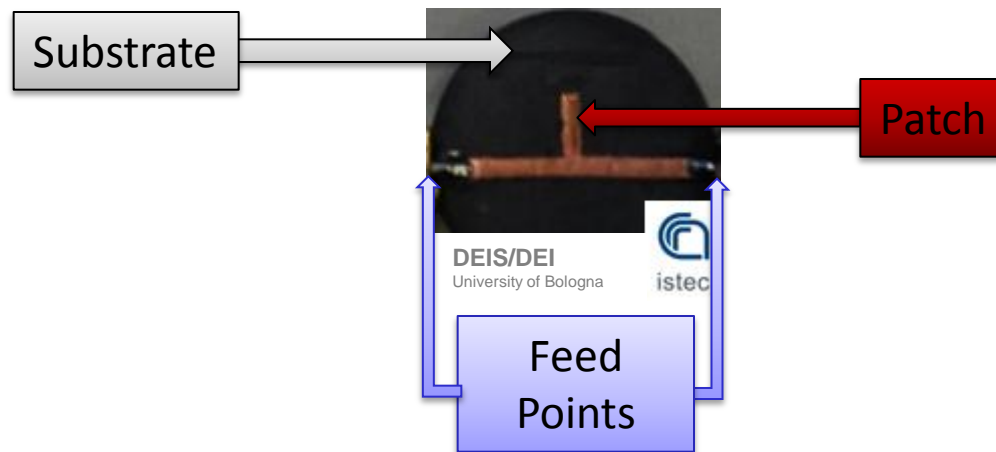
[] Martino Aldrigo, Davide Bianchini, Alessandra Costanzo, Diego Masotti, Carmen Galassi, Liliana Mitoseriu. New Broadband Button-Shaped Antenna on Innovative Magneto-Dielectric Material for Wearable Applications. *Proceedings of the 9th European Radar Conference*. Amsterdam (the Netherlands) 31 Oct – 2 Nov 2012.

Miniaturized Microstrip Antenna

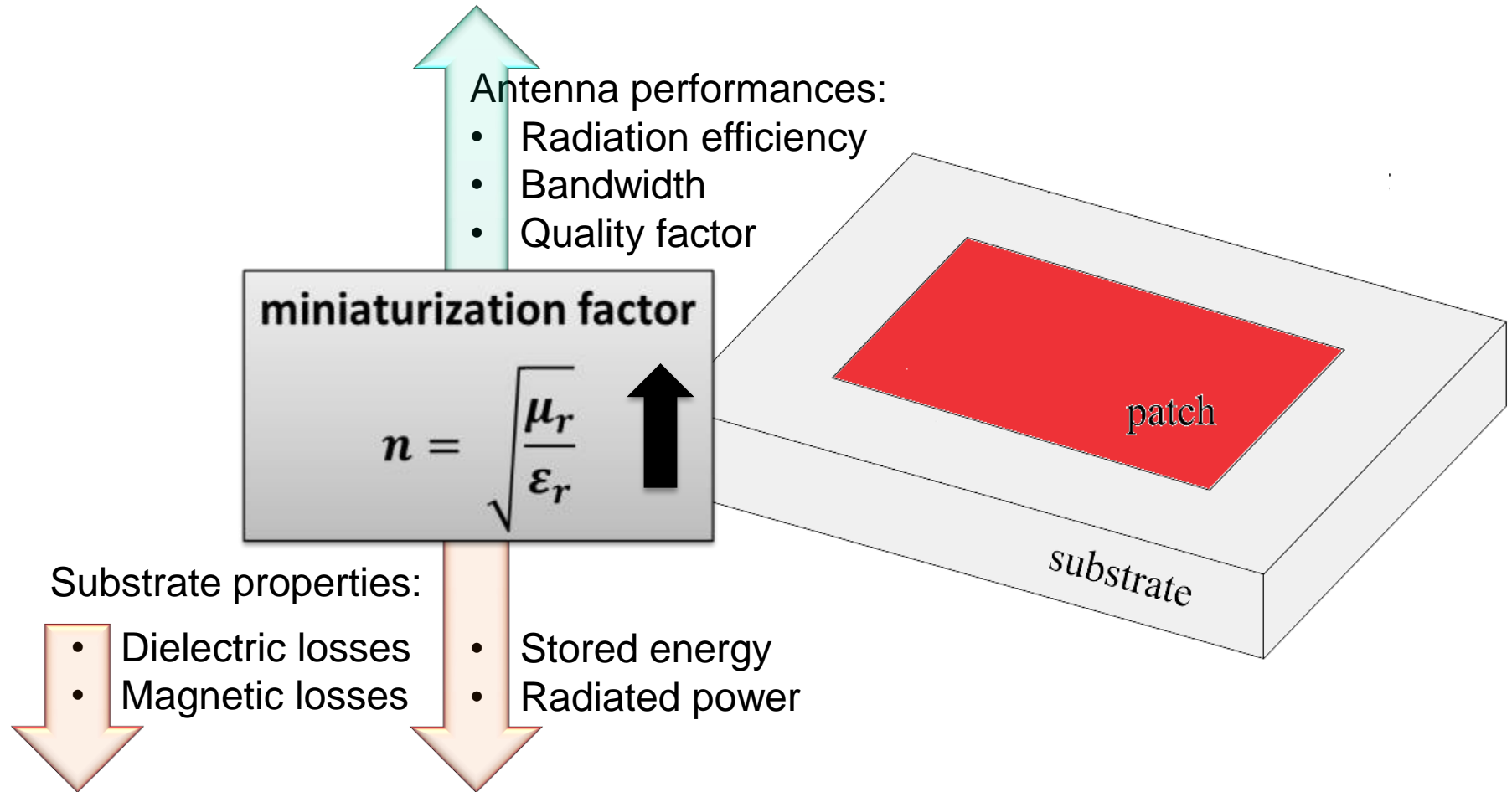
□ Main Application Area:

➤ **Miniaturized Microstrip Antennas**

- for wearable and wireless applications in the UHF



Design MD substrate



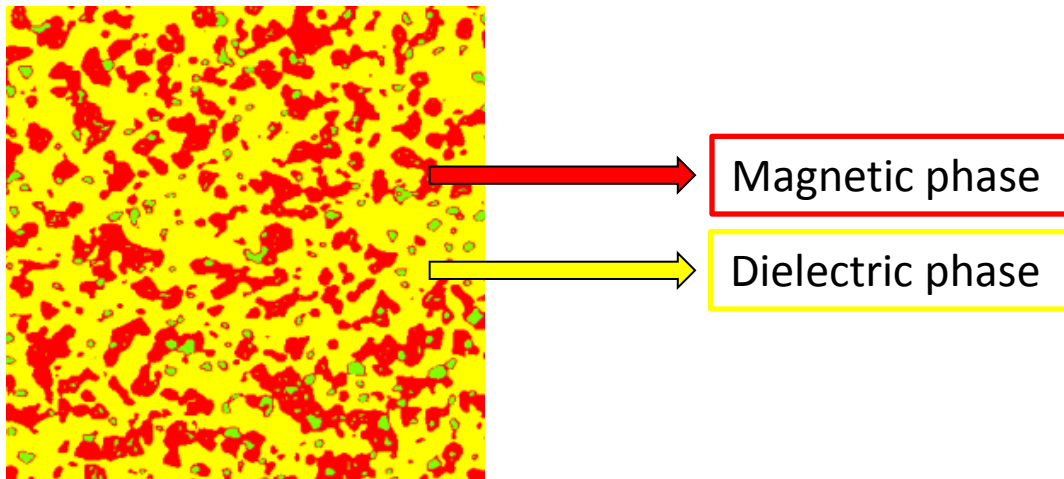
[] C. Niamien, S. Collardey and K. Mahdjoubi. *Printed antennas over lossy magneto-dielectric substrates*. European Conference on Antennas and Propagation 2010, 12-16 April 2010, Barcellona.

[] R.C. Hansen and Mary Burke. *ANTENNAS WITH MAGNETO-DIELECTRICS*. *Microwave and optical technology letters*. Vol. 26, No. 2, July 20 2000.

[] JF. Pintos, A. Louzir, P. Minard, J Perraudeau, JL. Mattei, D. Souriou, P. Queffelec. Ultra-Miniature UHF Antenna using Magneto dielectric Material.

Magnetodielectric Materilas - MDM's

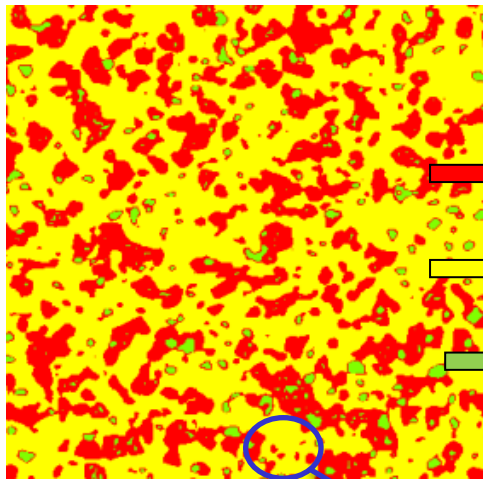
MDM's are composites with magnetic fillers in a dielectric matrix



The dielectric permittivity (ϵ) and magnetic permeability (μ) of MDM's can be tailored choosing the kind of magnetic and dielectric phases and their volume percentage in order to achieve **new electromagnetic properties**.

Microstructure

Electromagnetic properties

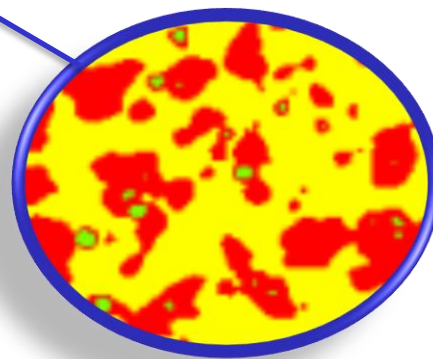


Vol. % Magnetic phase (μ)

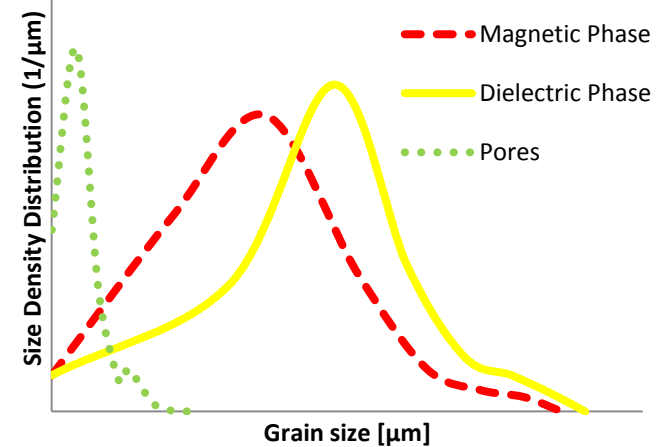
Vol. % Dielectric phase (ϵ)

Vol. % Pores

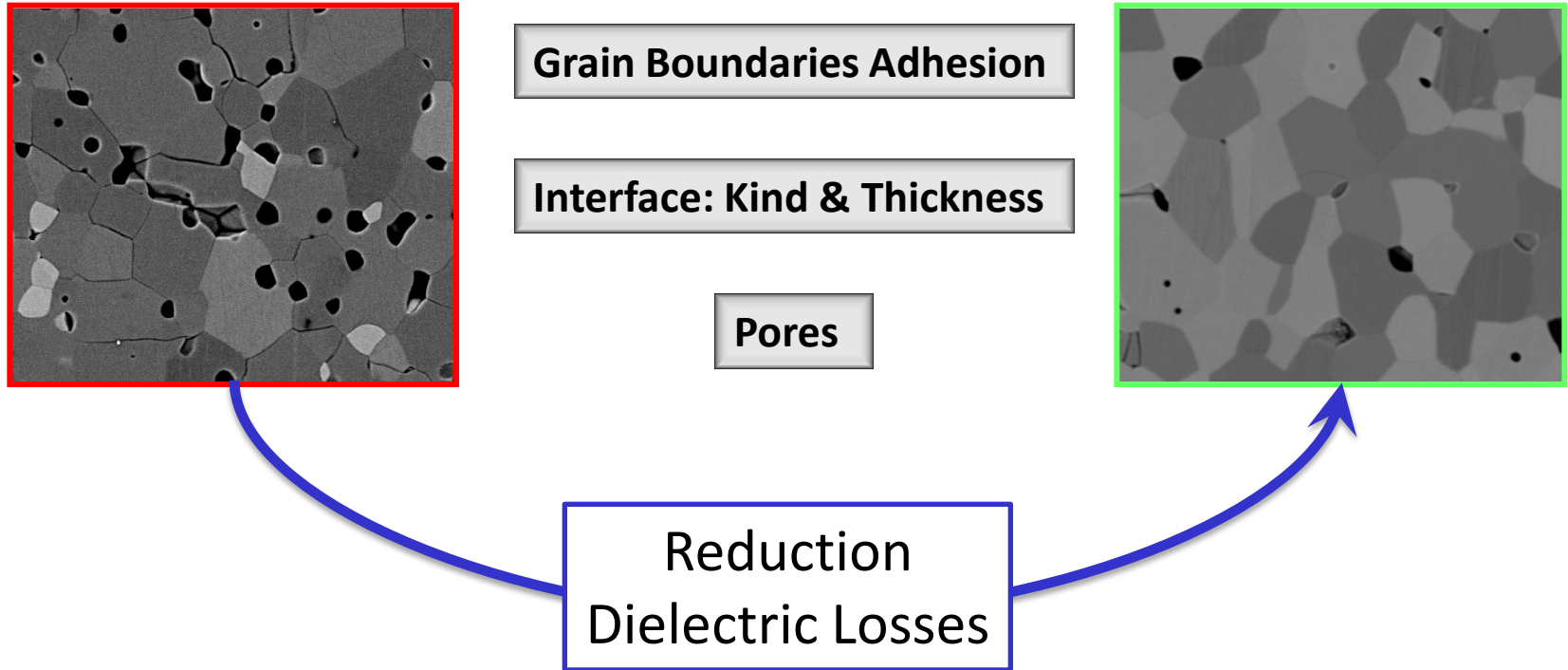
Phase Dispersion



Phase Distribution



Cobalt ferrite/titania composites as MD substrate



Cobalt ferrite/titania composites as MD substrate

Dielectric phase

Titania TiO_2

TO

Magnetic phase

Cobalt ferrite CoFe_2O_4

CFO

TO properties:

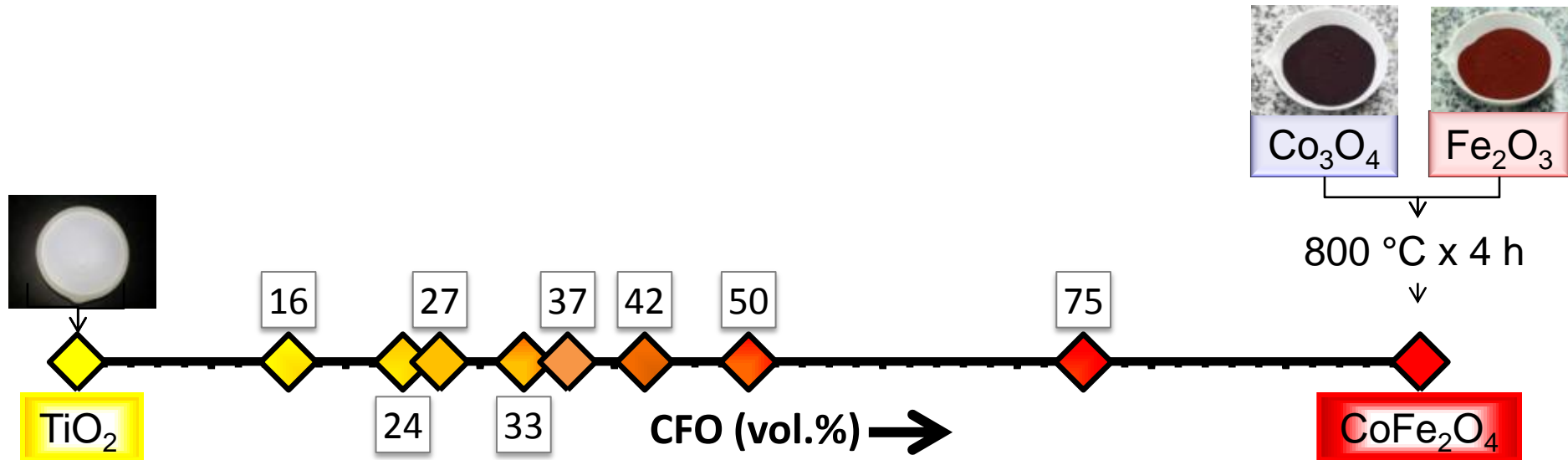
- low dielectric constant @UHF
- good process behaviour compared to others materials with low dielectric constant

CFO properties @RT:

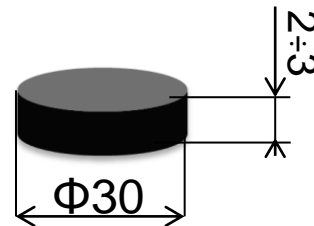
- high coercivity
- large magnetic anisotropy
- moderate saturation magnetization
- high resistivity
- good mechanical and chemical stabilities

Experimental

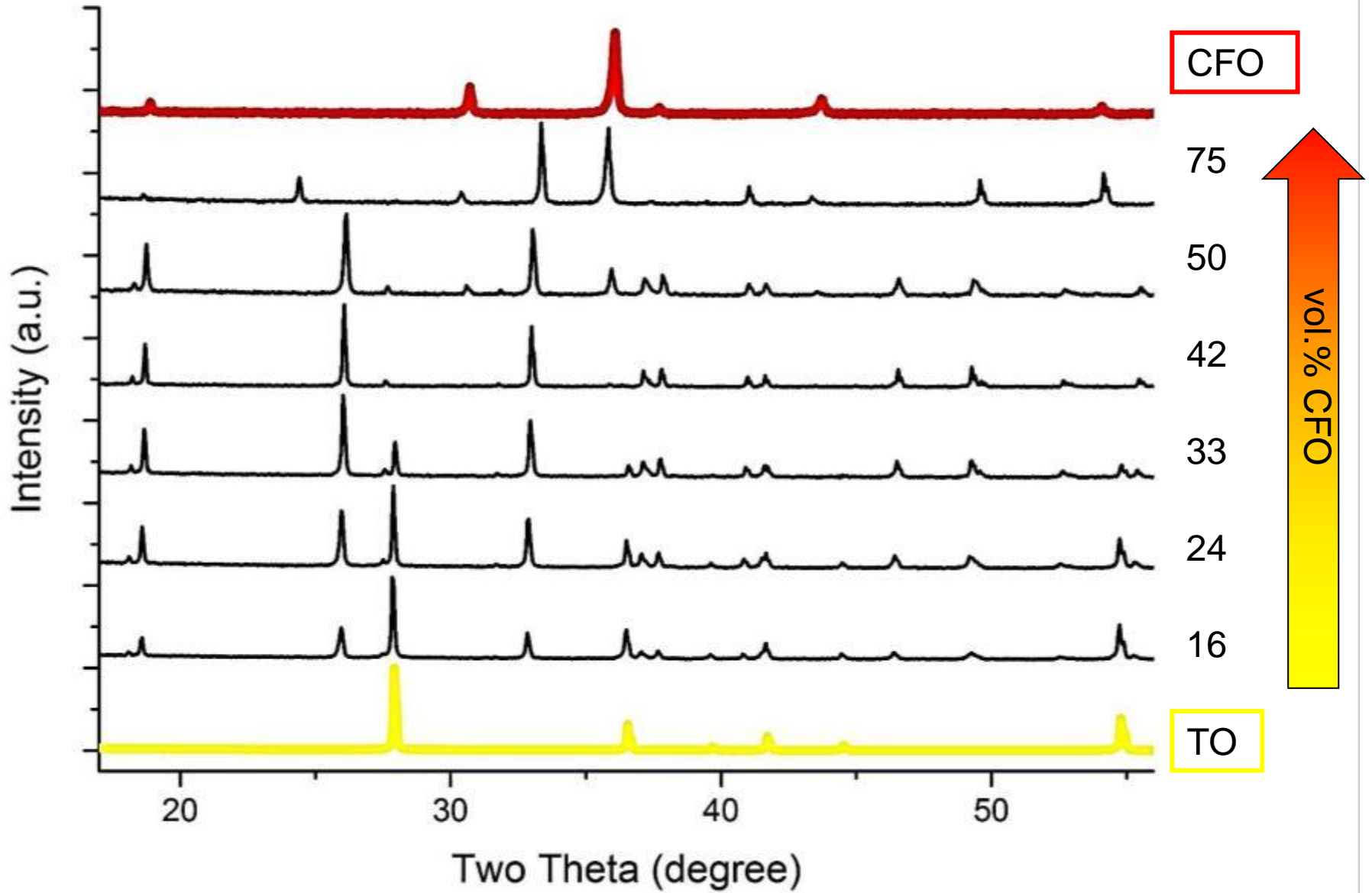
The samples were prepared by **solid state reaction** starting from commercial powders:



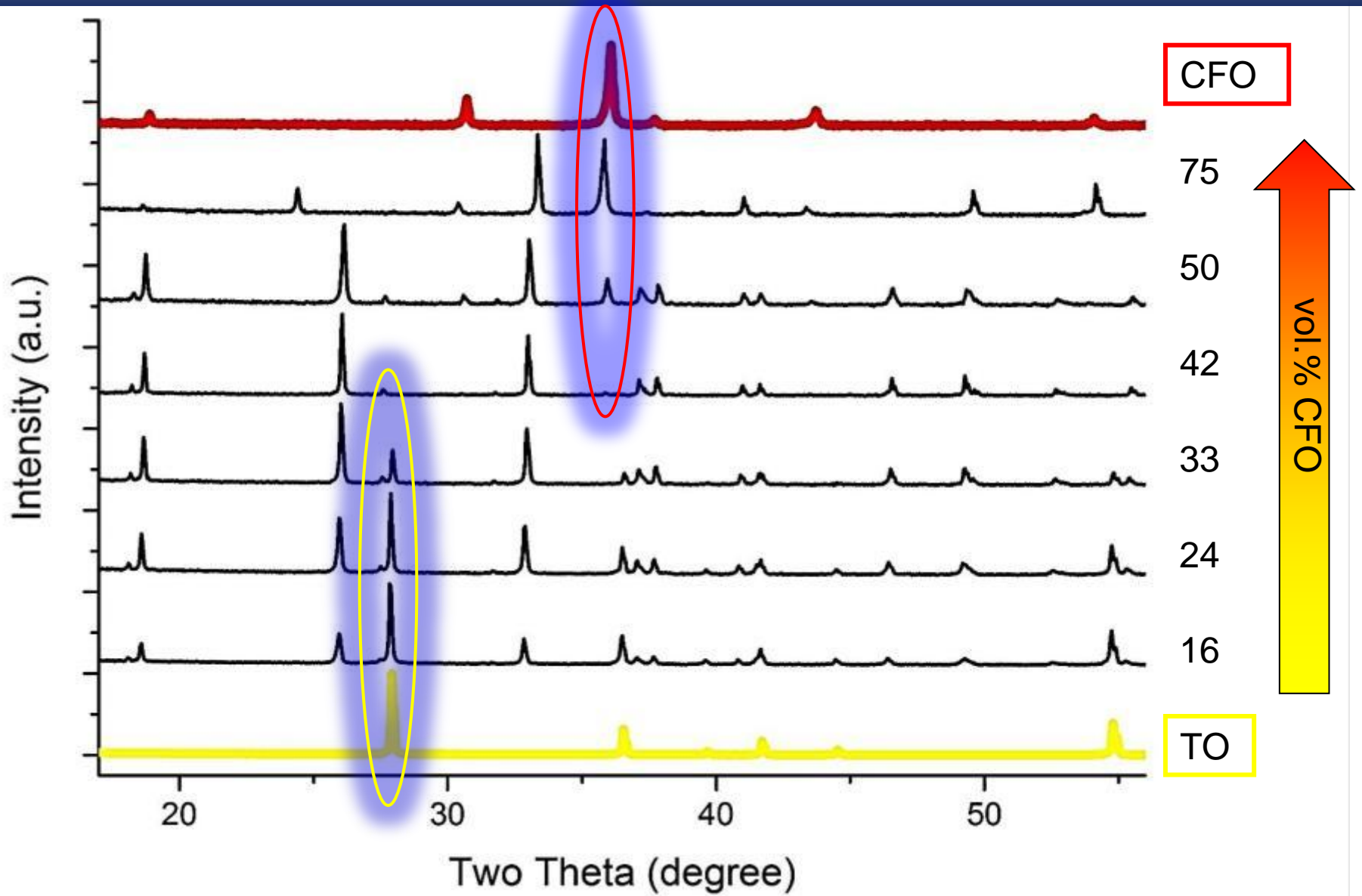
- mixing
- cold linear pressing at 70 MPa
- Isostatic pressing at 250 MPa
- sintered in air at $1200\text{ }^\circ\text{C}$ for 2 h



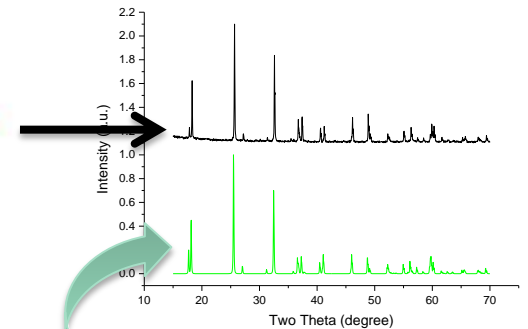
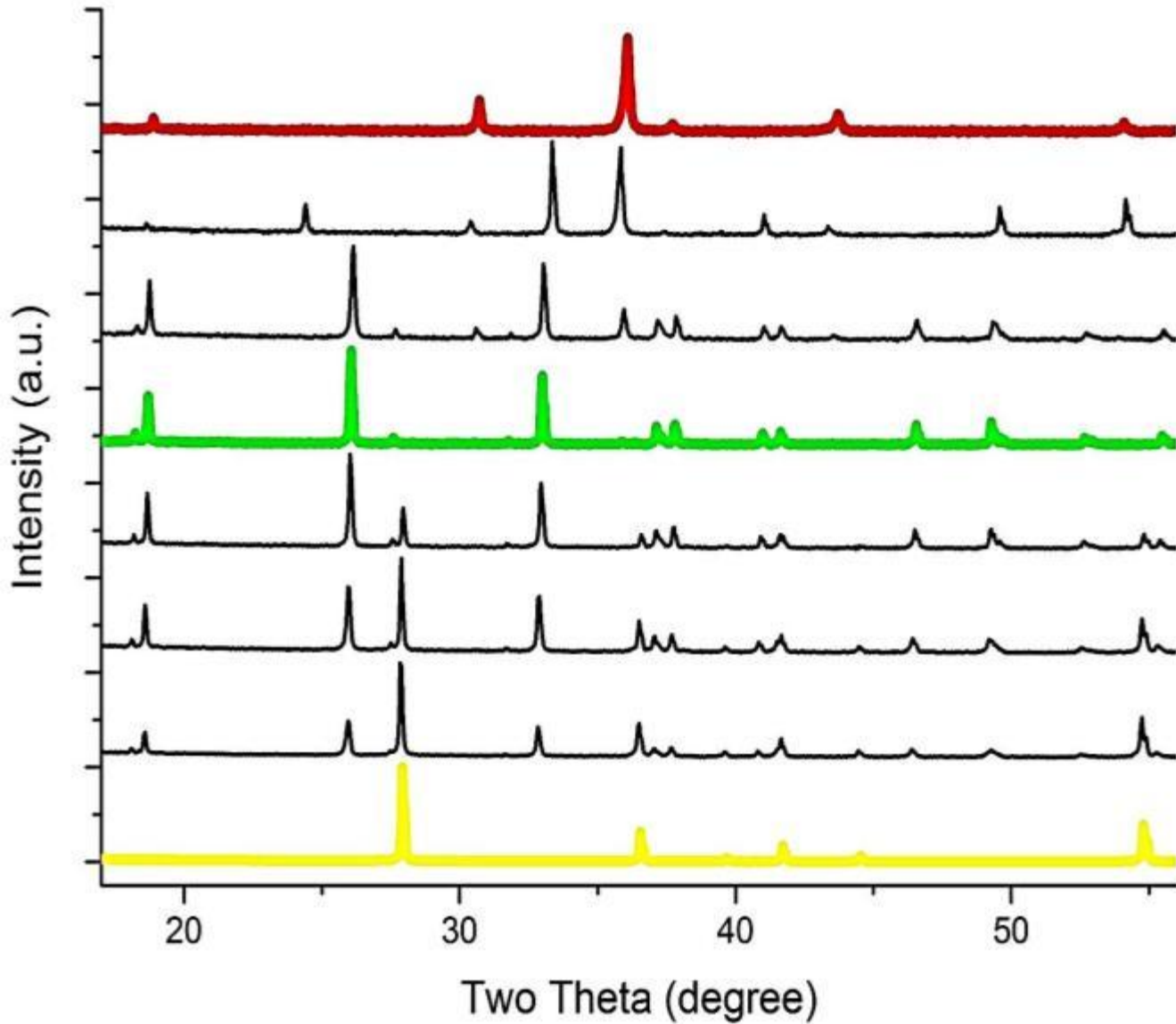
XRD



XRD



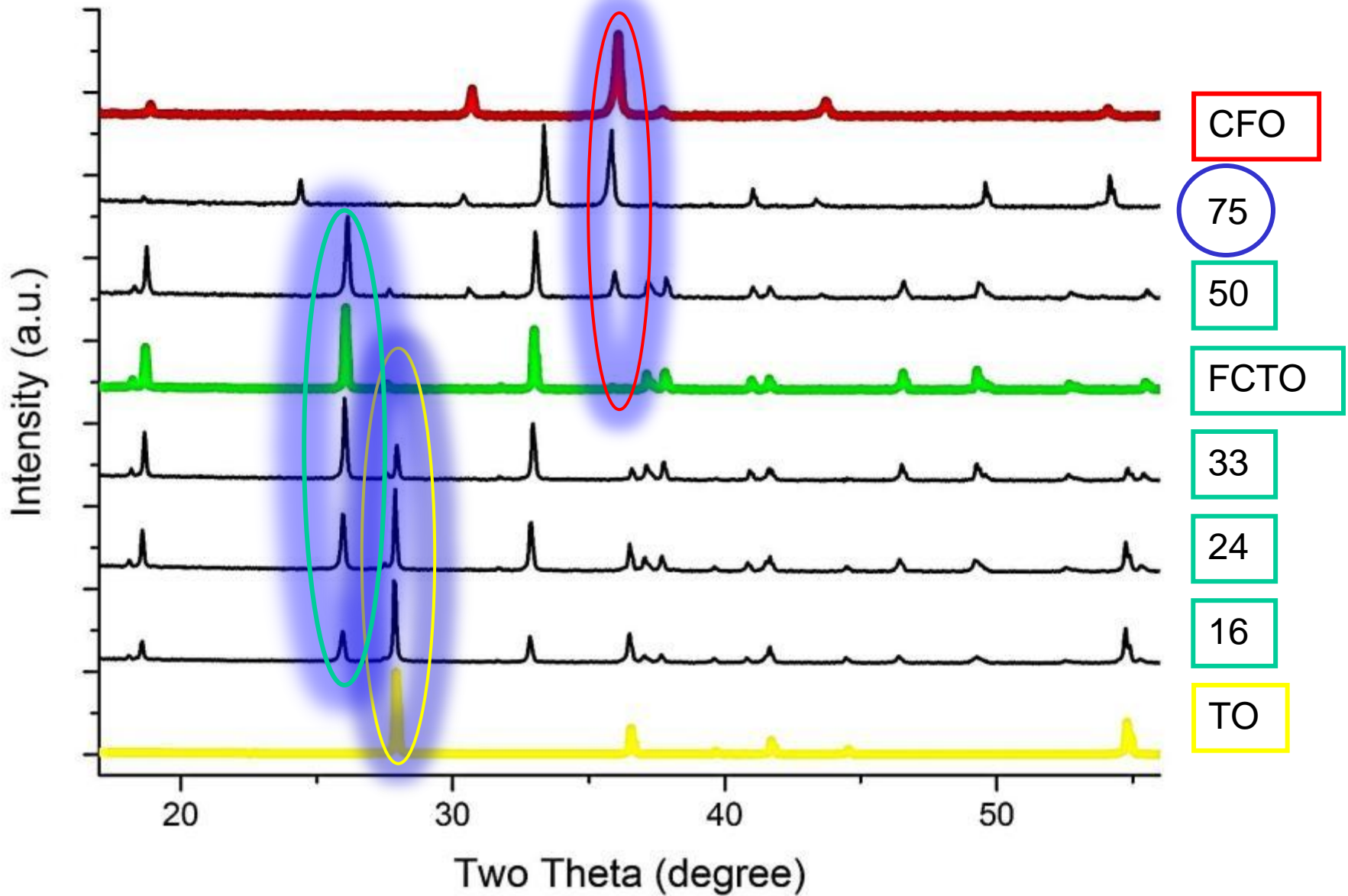
XRD



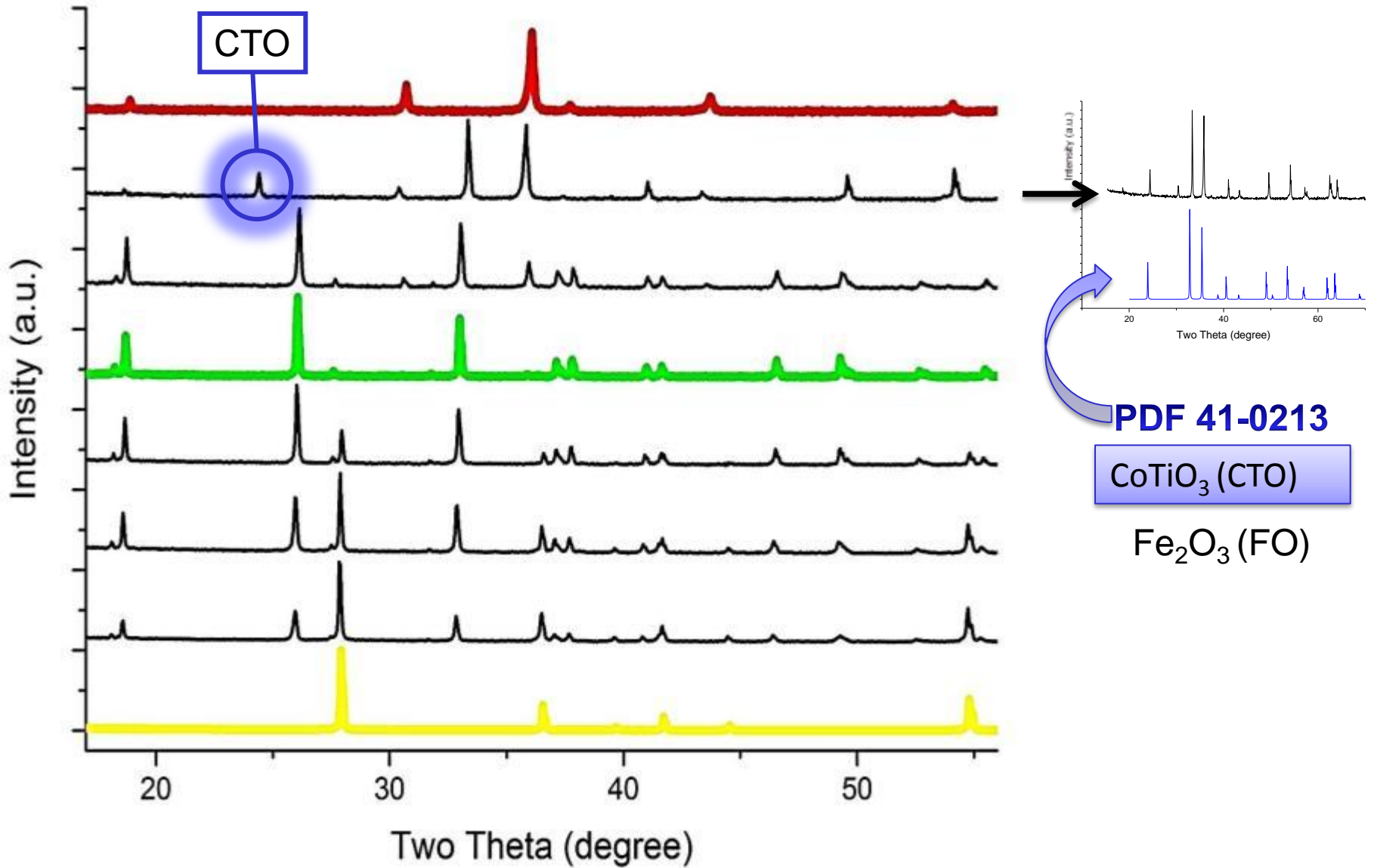
PDF 15-0866

$\text{Fe}_2\text{CoTi}_3\text{O}_{10}$ (FCTO)

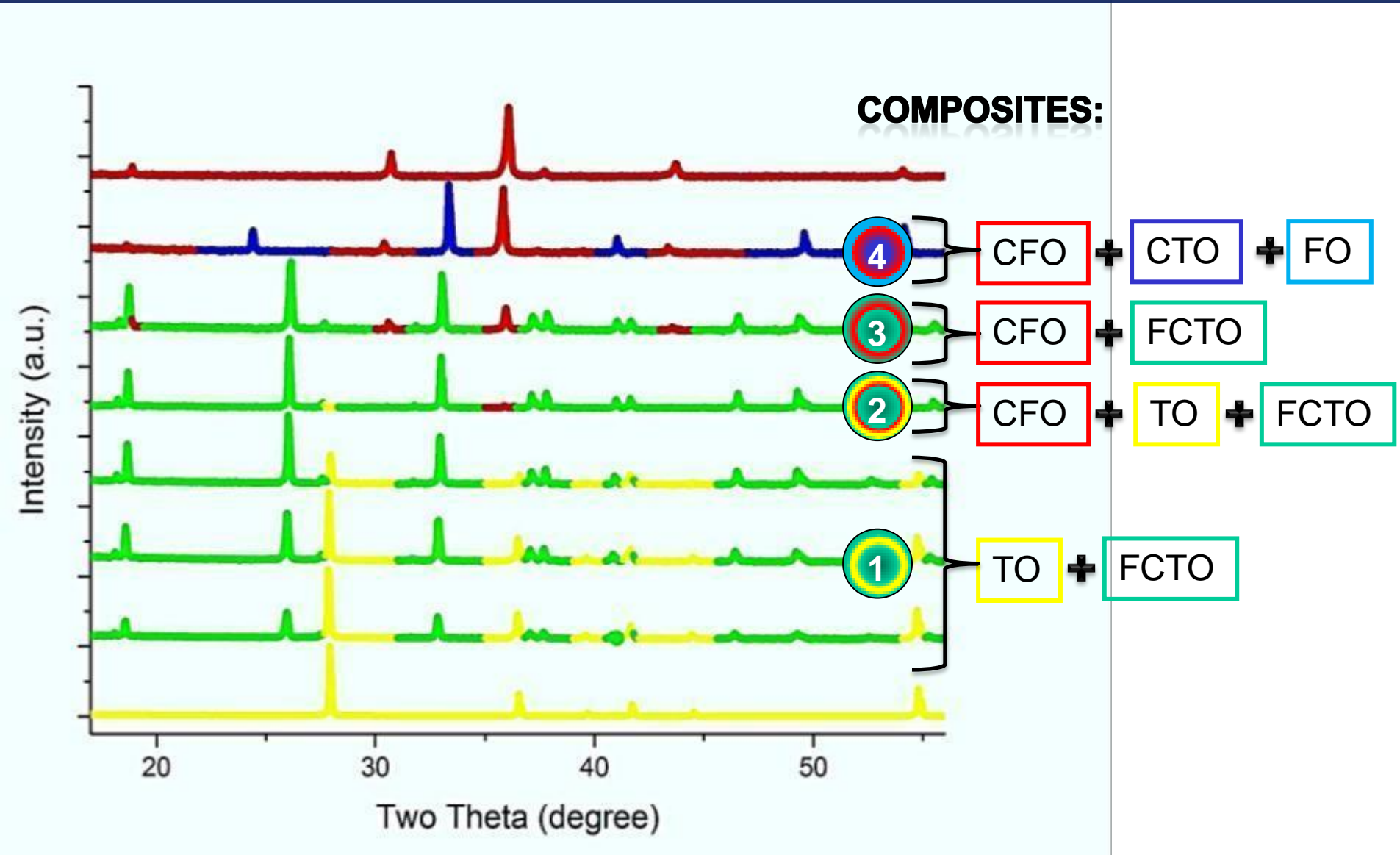
XRD



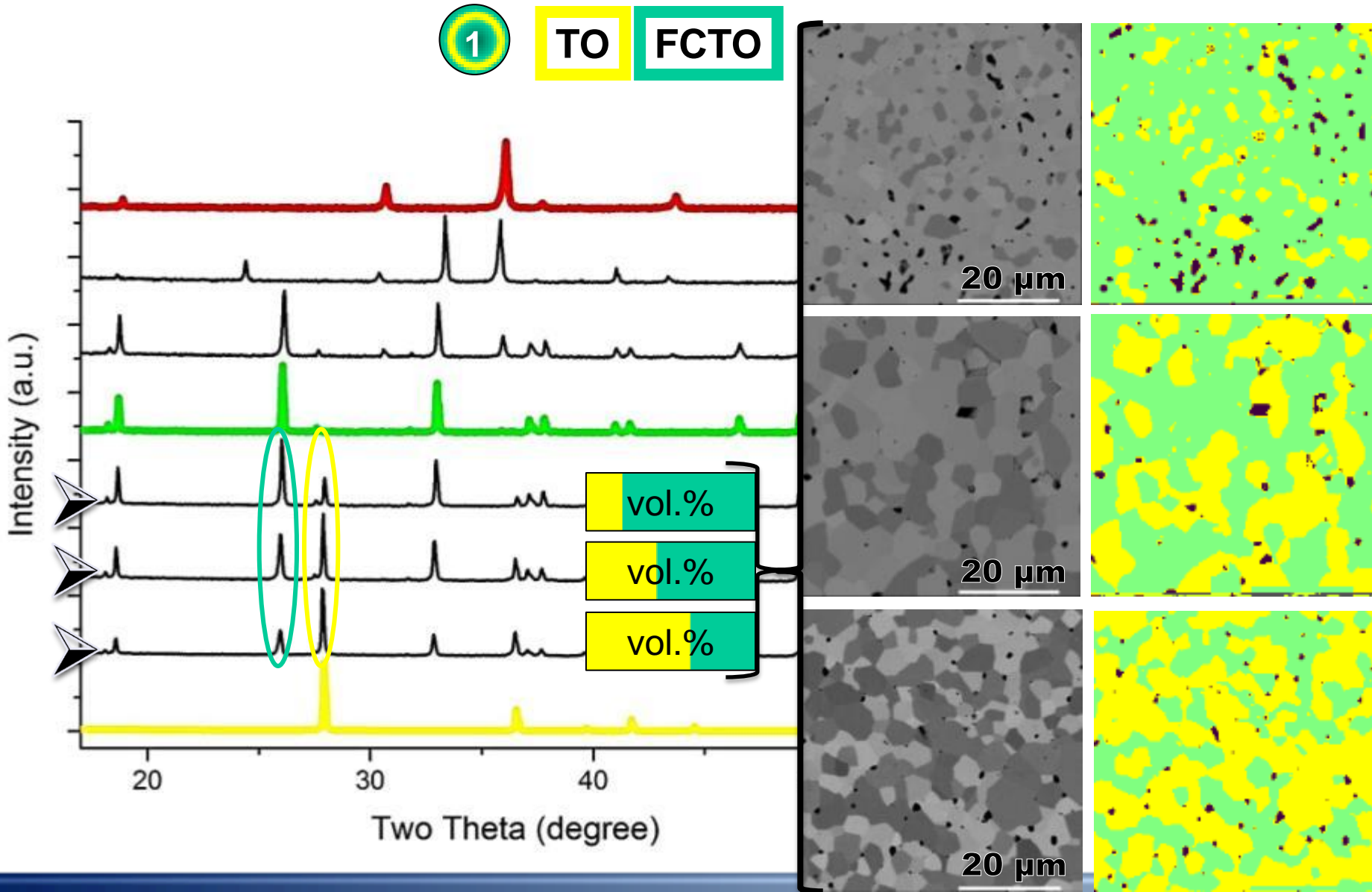
XRD



XRD



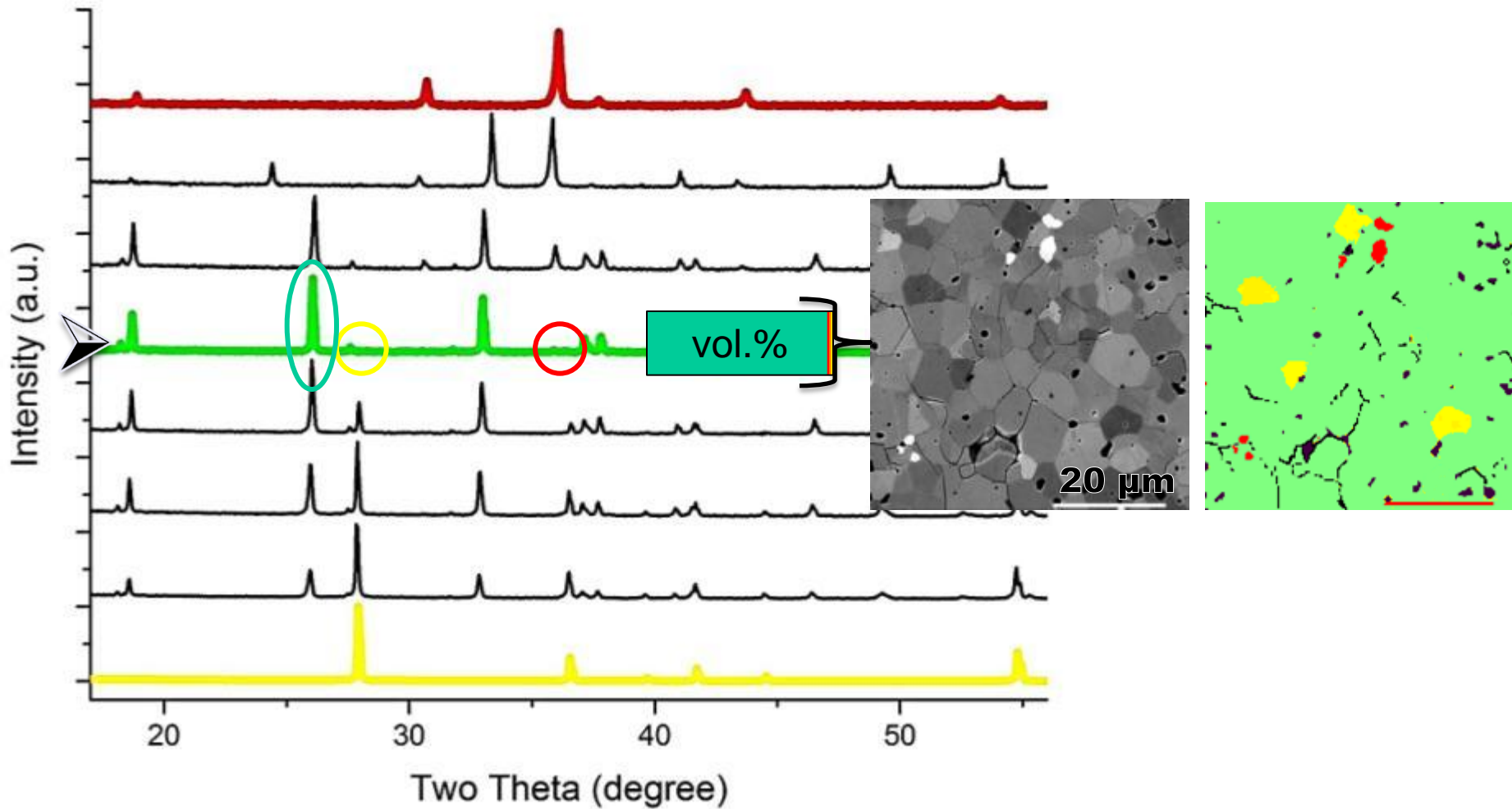
Microstructure



Microstructure



FCTO CFO TO

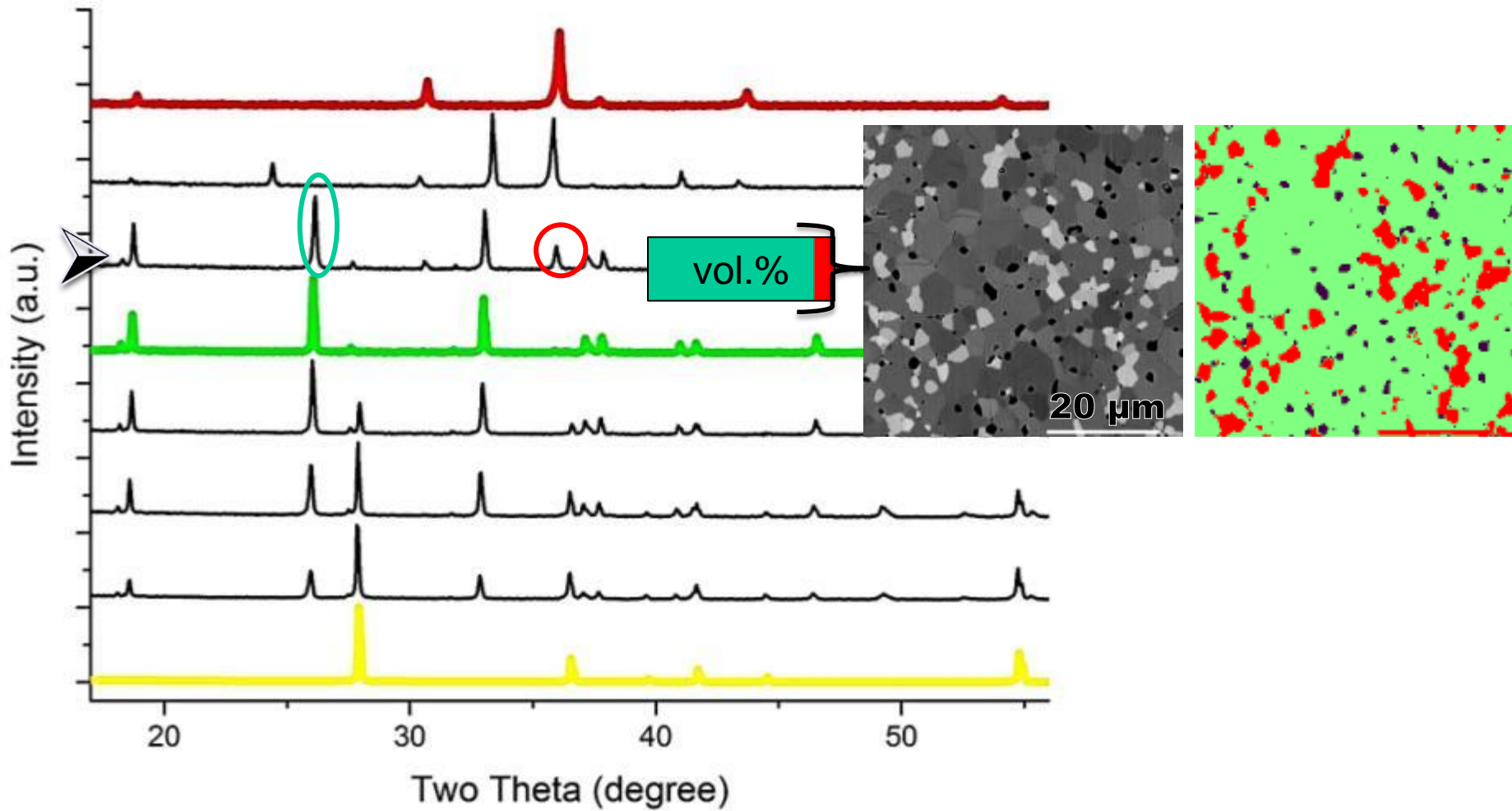


Microstructure

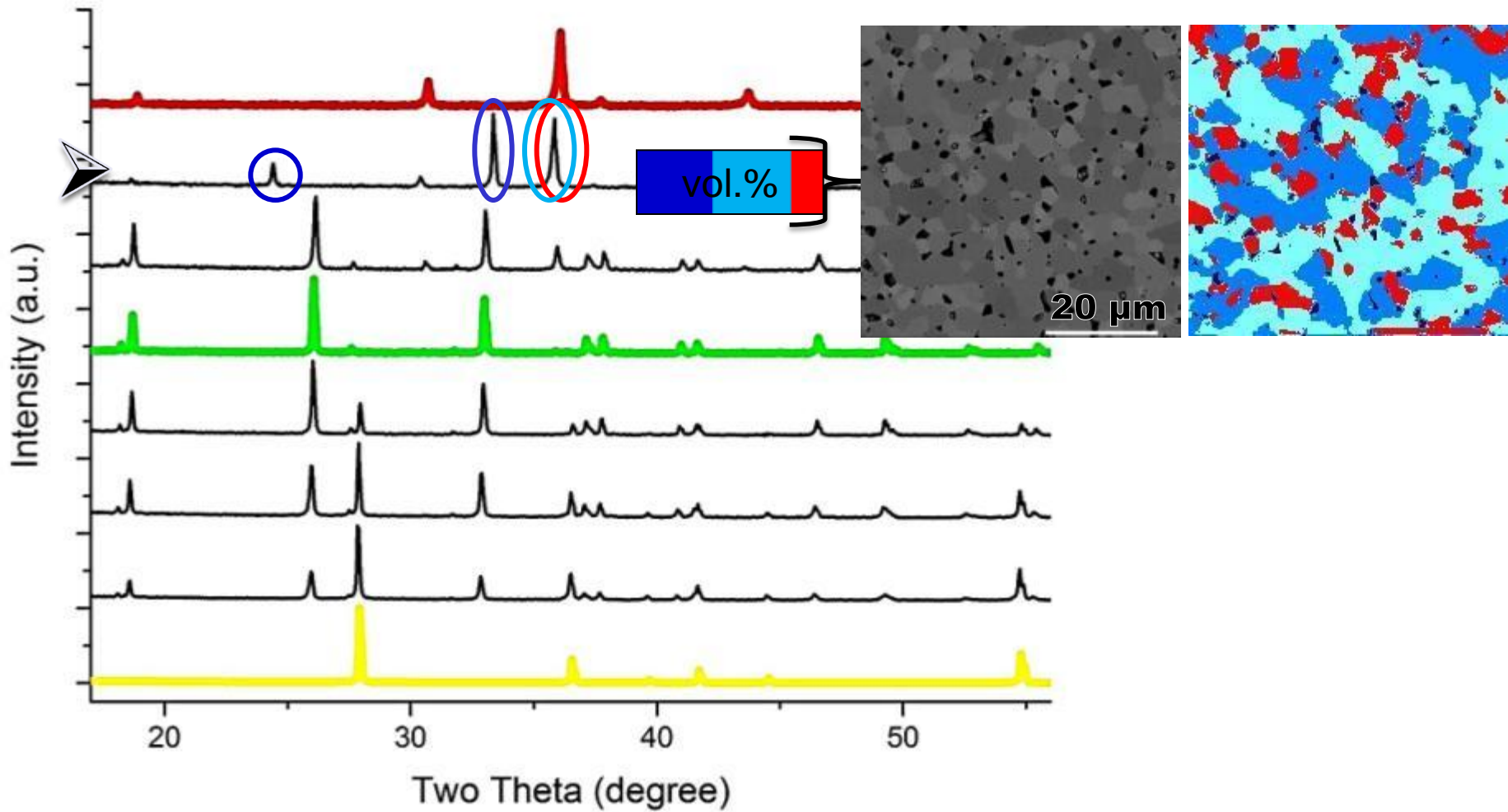
3

FCTO

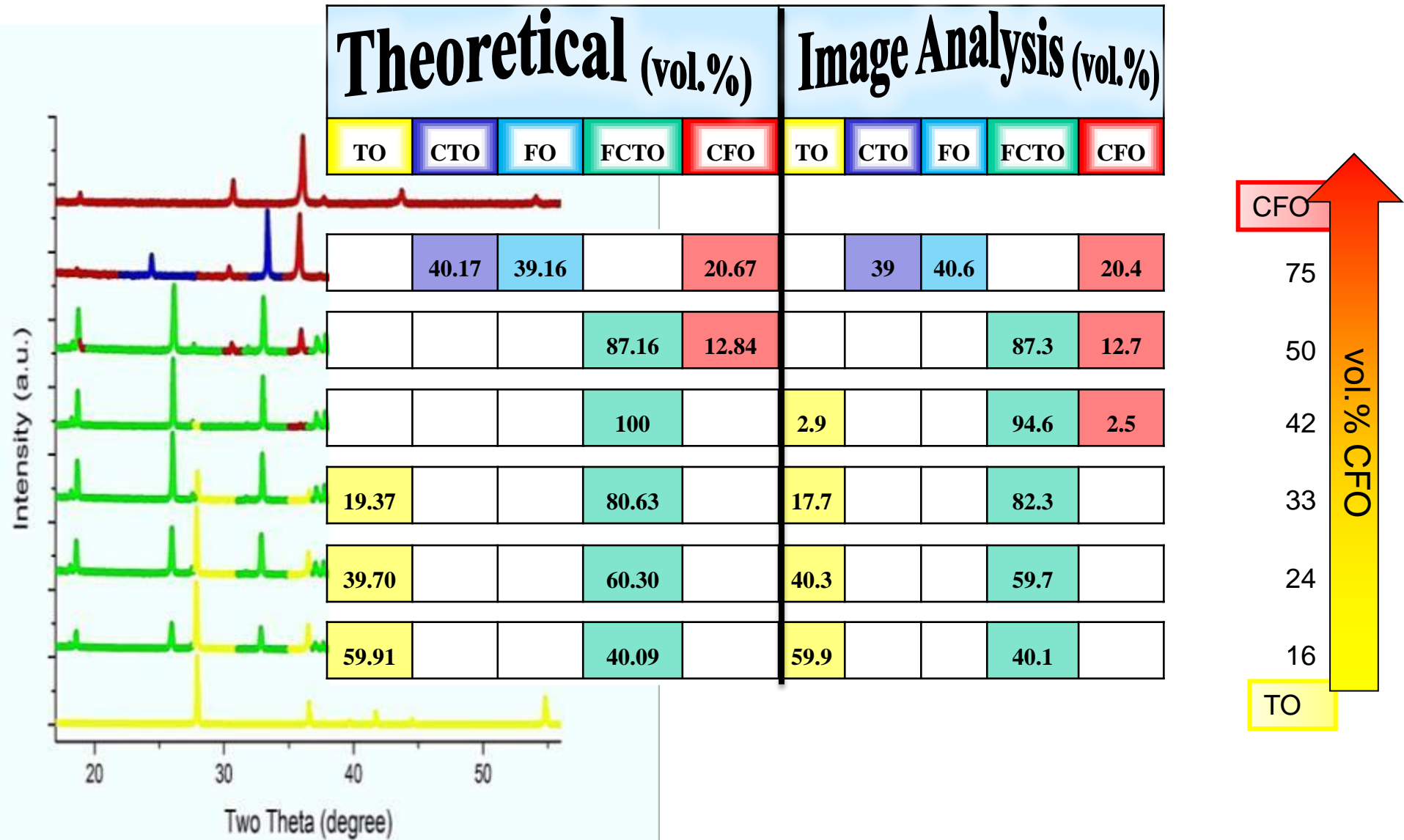
CFO



Microstructure

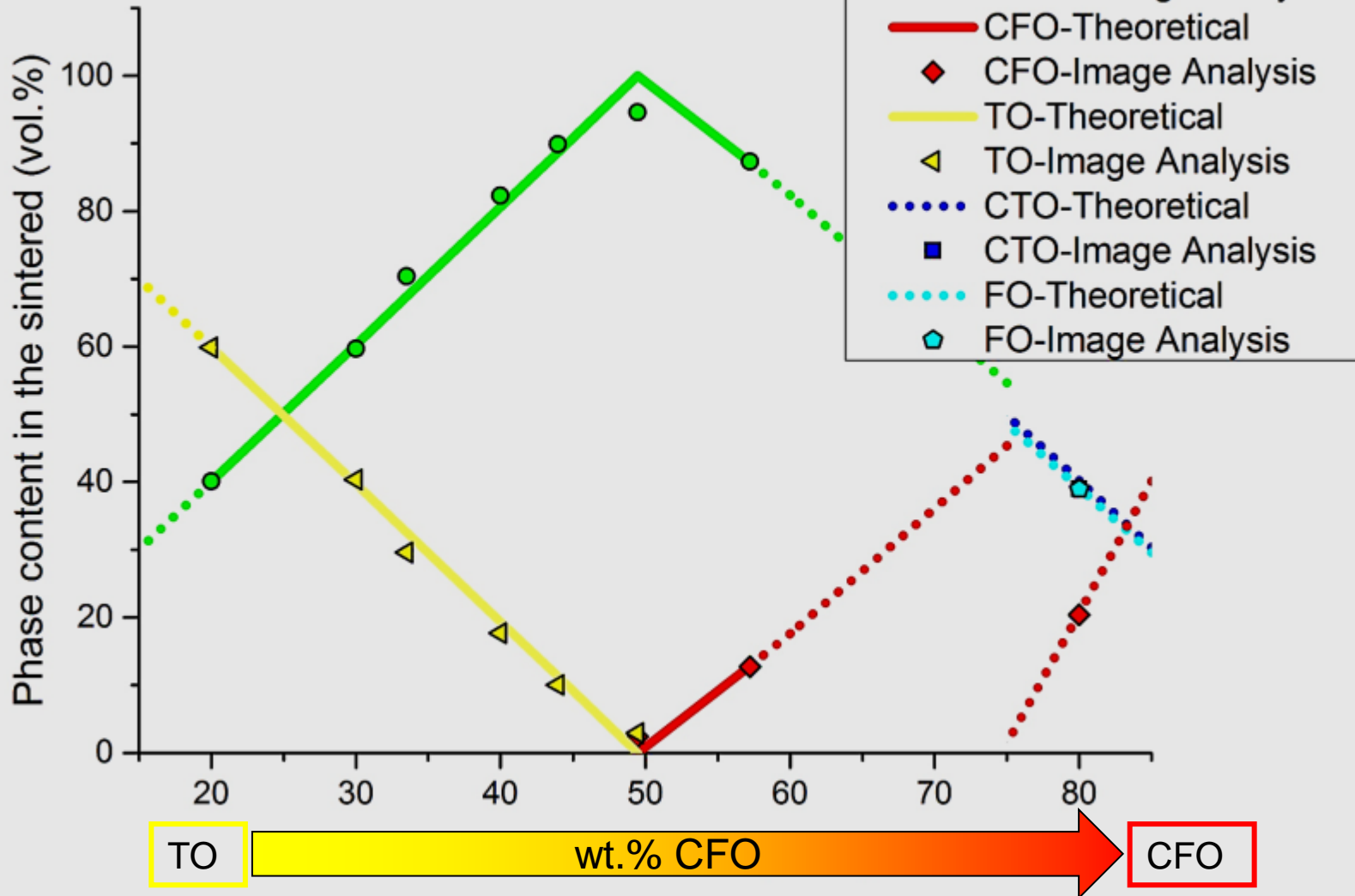


Results

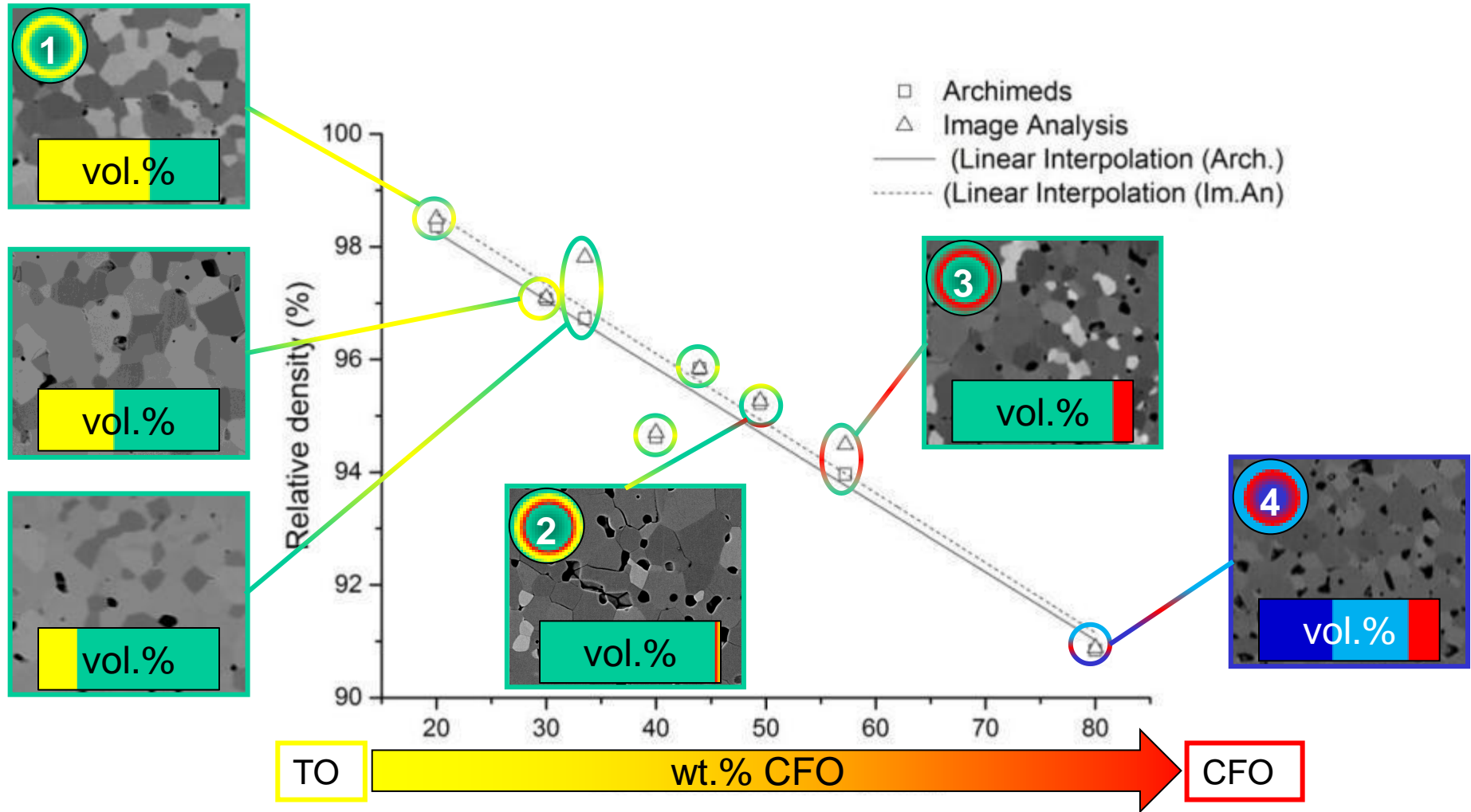


Results

Achievement of new electromagnetic properties tailoring magnetic and dielectric phases



Results



Conclusions

1. New composite ceramic materials were produced by combining a magnetic and a dielectric phases in order to investigate the possibility to tailor their magneto-dielectric properties
2. The microstructural characterization of the several compositions investigated evidenced that new phases are formed during the heat treatments.
3. The results show that it is possible to design the final composition by controlling the ratio of the dielectric to the magnetic starting phases.
4. The study of the magnetic and dielectric properties is now still in progress.
5. Further investigations will be performed to better control the residual porosity after sintering.



Thank you for your kind attention

