Sustainable low-temperature hydrothermal synthesis of ternary and quaternary transition metal ferrites

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Hydrothermal inorganic synthesis is very important due to its sustainable approach with regard to following the Green Chemistry principles, affording an easy (one-step), reproducible, low-temperature synthetic route [1]. Ternary and quaternary spinel ferrites, MFe_2O_4 and $M_{(1-x)}M'_xFe_2O_4$ respectively (where x = 0.2, 0.4, 0.6, 0.8 and M, M' = Co, Ni, Mn, Zn,), have been synthesised through a low temperature (T= 135 °C) and green protocol combining the coprecipitation of metal salt precursors *via* oxalic acid and subsequent hydrothermal treatment [Figure 1].The obtained powders were analysed by XRD, XPS and ICP-MS. These studies have shown that this approach allowed to obtain monophasic nanocrystalline materials with excellent compositional control, allowing to control the value of x, with the possibility to potentially tune the functional properties of the final materials. Further it was shown that nanosized crystalline materials can be obtained with treatment times as short as one hour and that, moreover, differences in treatment time can have notable influence on the spinel's final degree of inversion [3]. Further advantages of the protocol include its extreme simplicity, the lack of complex, expensive and/or toxic precursors, the ease with which obtained materials can be purified and the compatibility with scaling up to higher production levels.

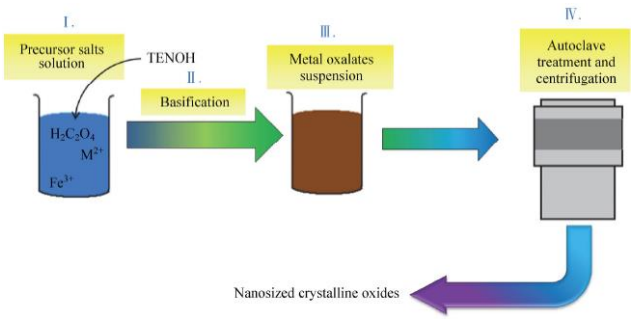

Figure 1.Synthesis scheme of transition metal ferrites [2]

[1] Diodati, S.; Dolcet, P.; Casarin, M.; Gross, S., *Chem. Rev.* **2015,** *115* (20), 11449-11502.
[2] Diodati, S.; Pandolfo, L.; Caneschi, A.; Gialanella, S.; Gross, S., *Nano Res.* **2014**, 7 (7), 1027-1042.
[3] Dolcet, P.; Diodati, S.; Zorzi, F.; Voepel, P.; Seitz, C.; Smarsly, B. M.; Mascotto, S.; Nestola F.; Gross, S., *Green Chem*. **2018,** *20* (10), 2257-2268.