Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

Enhancing the strain sensitivity of $CoFe_2O_4$ at low magnetic fields without affecting the magnetostriction coefficient by substitution of small amounts of Mg for Fe

P. N. Anantharamaiah[1,2] and P. A. Joy[1,2,*]

[1] Physical and Materials Chemistry Division, CSIR-National Chemical Laboratory (CSIR-NCL), Pune 411008, India

[2] Academy of Scientific and Innovative Research (AcSIR), CSIR-NCL, Pune 411008, India

Table S1 The Rietveld refinement parameters, weighted profile factor (R_{wp}), profile factor (R_p), goodness of fit (χ^2), and oxygen positional parameter (u)

x in $CoMg_xFe_{2-x}O_4$	**R_{wp} (%)**	**R_p (%)**	**χ^2**	**u (Å)**
0.0	3.2	2.4	1.4	0.382
0.025	2.5	1.9	1.2	0.380
0.05	2.4	2.0	1.1	0.382
0.10	2.7	2.1	1.1	0.383
0.15	2.9	2.2	1.3	0.379
0.20	3.2	2.5	1.5	0.381

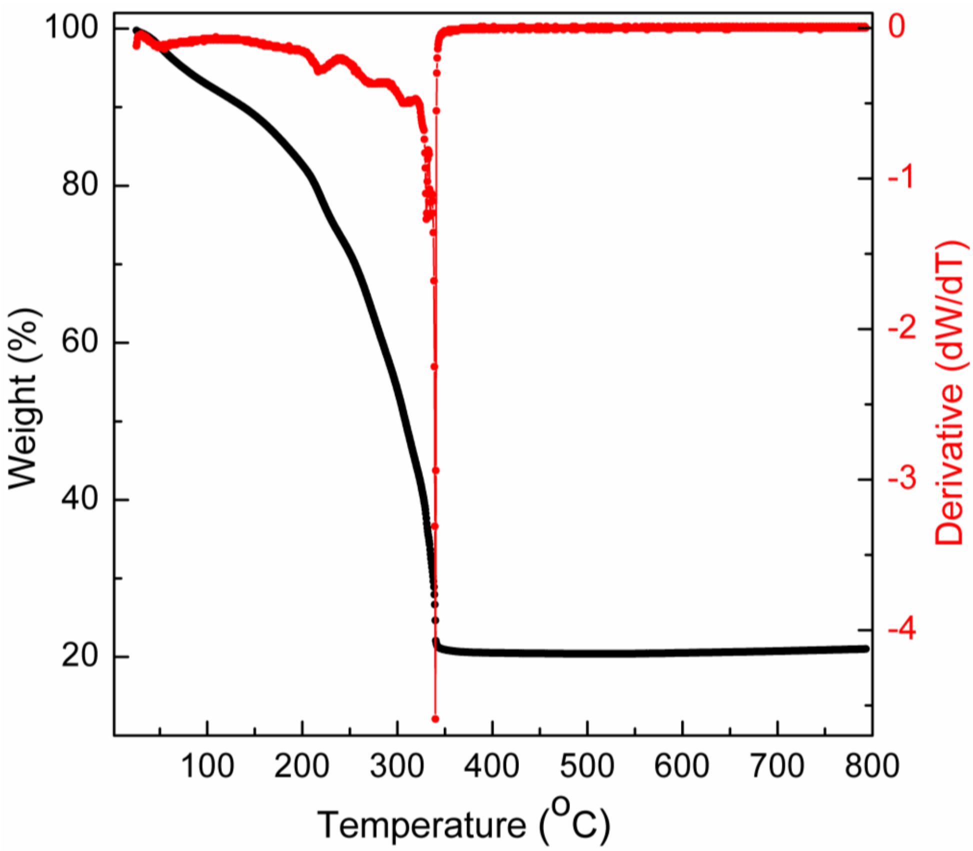

Fig. S1 Thermogravimetric analysis (black) and the corresponding derivative (red) curves of dried precursor for cobalt ferrite.

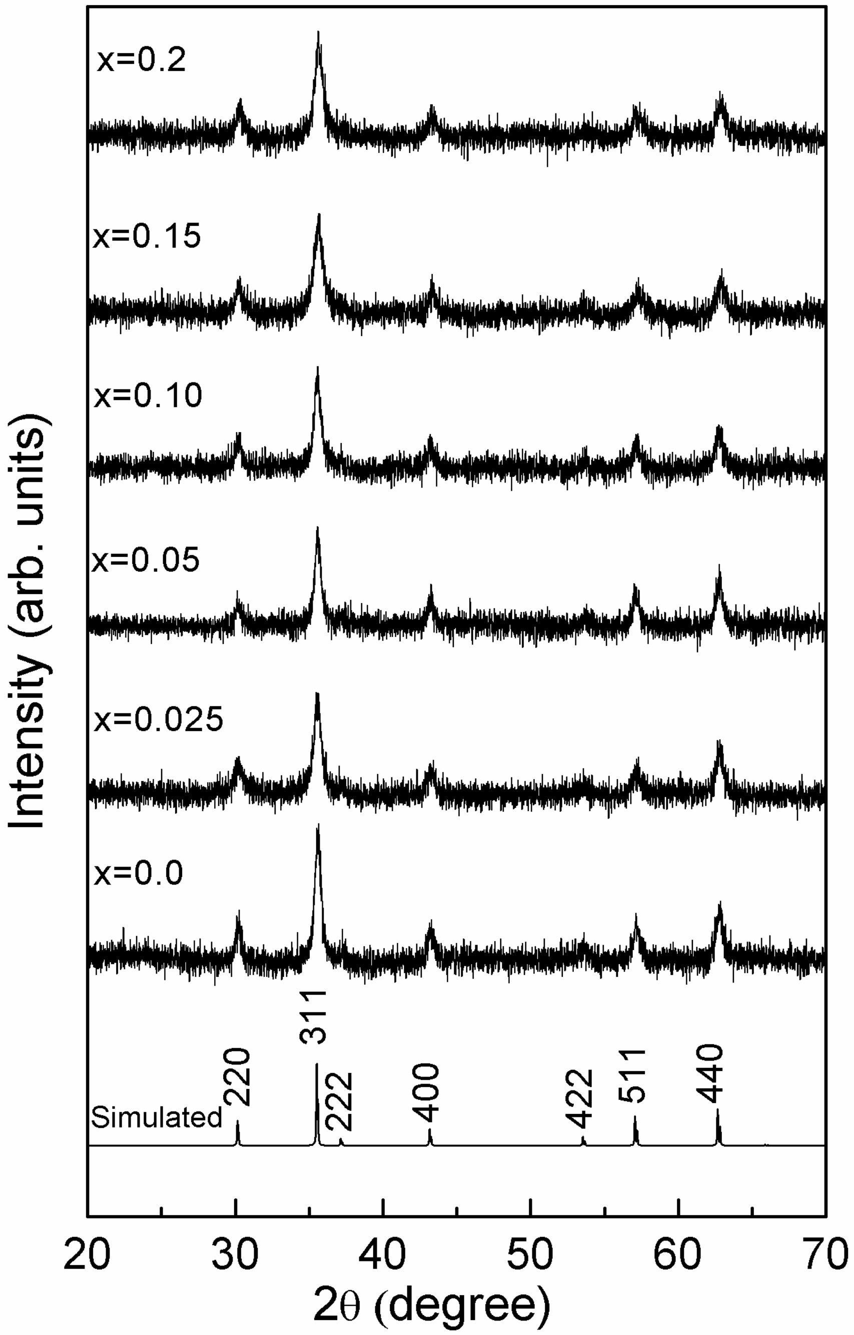

Fig. S2 X-ray diffraction patterns of the calcined powders of $CoMg_xFe_{2-x}O_4$. The simulated pattern of $CoFe_2O_4$ is shown at the bottom.

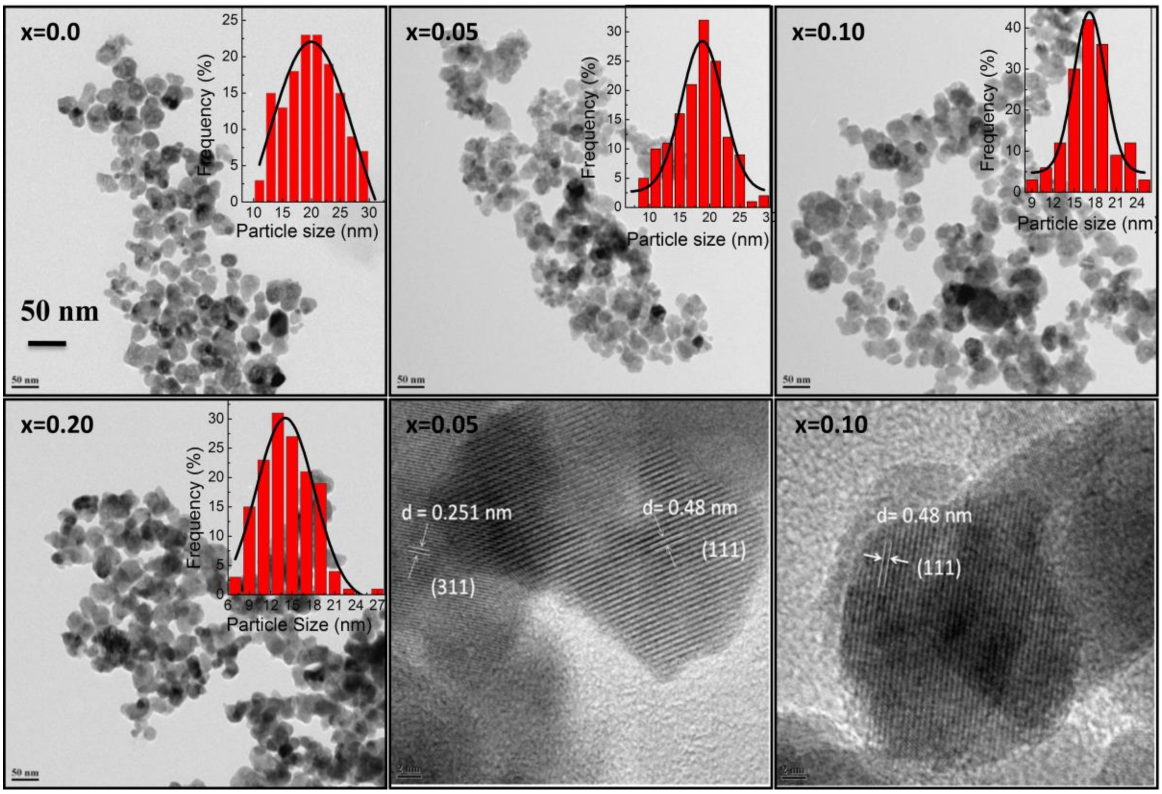

Fig. S3 TEM images of the calcined samples of $CoMg_xFe_{2-x}O_4$. The particle size histograms are shown in the insets.

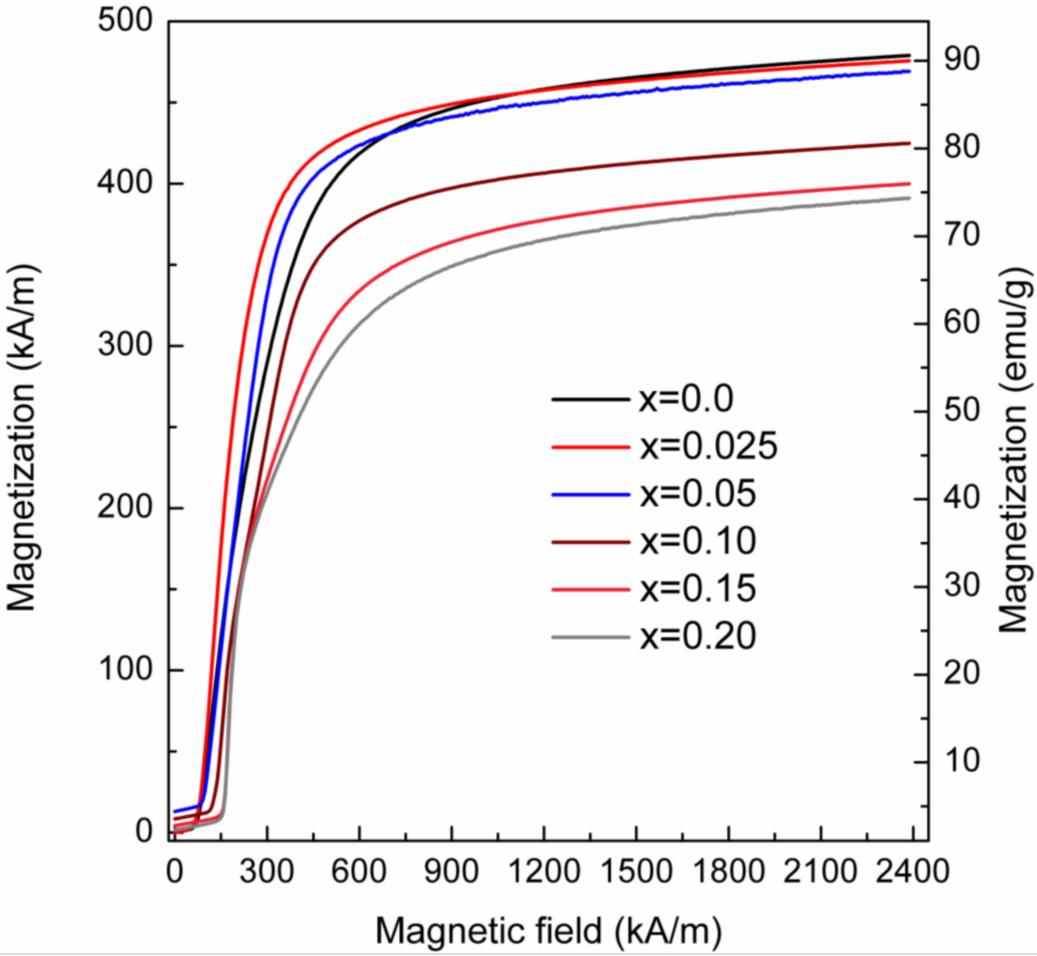

Fig. S4 Initial magnetization curves of the sintered $CoMg_xFe_{2-x}O_4$ samples measured at 5K.

Magnetocrystalline anisotropy

According to law of approach to saturation (LoA), the high field regions ($H>>H_{coercivity}$) of M-H loop can be described by the equation

$$M = M_s\left[1 - \frac{8}{105}\frac{K_1^2}{\mu_0^2 H^2}\right] + kH$$

where, M is the magnetization in kA/m, M_s is the saturation magnetization in kA/m, H is the applied magnetic field in kA/m, K_1 is the first order cubic magnetocrystalline anisotropy coefficient in J/m^3, μ_o is the permeability of free space (1.257×10^{-6} $mkgs^{-2}A^{-2}$) and kH is the forced magnetization coefficient that describes the linear increase in the spontaneous magnetization at high fields and at higher temperature regions. The constant 8/105 is specific to cubic anisotropy of randomly oriented polycrystalline materials. At temperature above 150 K, data from the field region $\mu_o H \geq 1T$ can be fitted to the above equation to determine the values of parameters M_s, K_1 and k. At room temperature, forced magnetization term kH is set to be zero (k=0), since it has to be fitted at high temperature and high field region and therefore, M_s and K_1 are only the fitting parameters at room temperature.

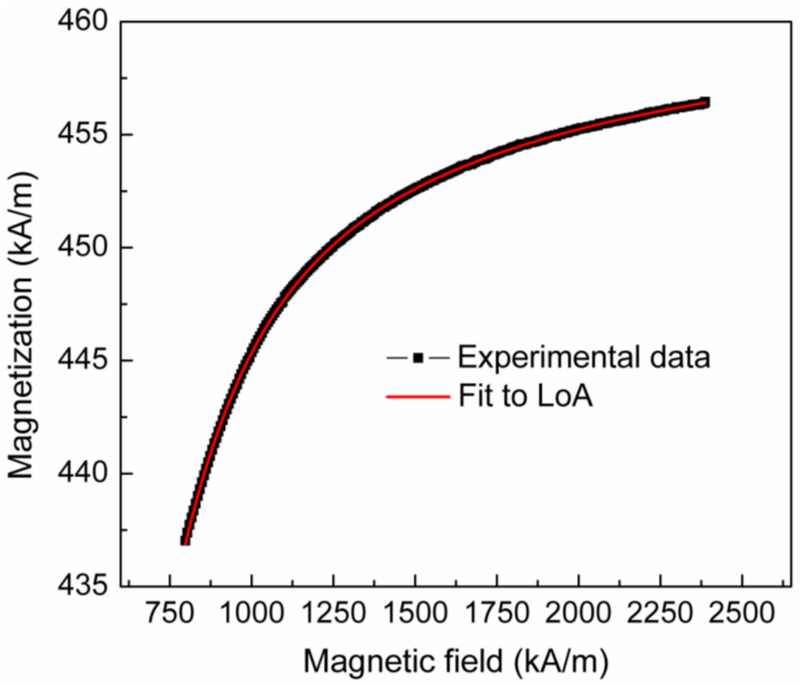

Fig. S5 Fit of the high field magnetization of sintered cobalt ferrite at room temperature, using the law of approach to saturation.