Electronic Supplementary Material (ESI) for ChemComm.

Exchange Coupled Ferrite Nanocomposites through Chemical Synthesis

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Experimental methods

The cobalt ferrite (CFO) nanoparticles with different structures are synthesized by a standard schlenk line method. The CFO nanoparticles are prepared by heating $Co(acac)_2$ and $Fe(acac)_3$ in a mixture solution of oleylamine, oleic acid and 1-octadecene (ODE) at 300 ^{o}C for 2h. The strontium ferrite (SFO) powders are synthesized by the similar method, using $Sr(acac)_2$ and $Fe(acac)_3$ in a mixture solution of oleylamine, oleic acid and 1-octadecene (ODE) at 300 ^{o}C for 2h. The CFO and SFO composites are prepared by putting CFO nanoparticles with SFO starting materials together followed by the same procedure for the SFO synthesis. The thermal treatment is applied to the obtained powders by annealing the nanocomposites at 1000 ^{o}c for 12 hours, and furnace cooled to 600 ^{o}c before fast quenching to room temperature.

Starting CFO:SFO	**1:0.3**	**1:0.6**	**1:1.25**	**1:2.5**	**1:5**	**1:10**	**1:20**	**1:40**
EDX	1:0.23	1:0.38	1:0.95	1:1.56	1:3.46	1:7.23	1:12	1:30
Mr	33.1	30.0	28.3	27.9	26.7	23.1	21.1	19.7
Ms	66.6	58.6	52.6	52.2	51.2	42.7	39.0	36.5
Hc	1520	1788	2046	3214	3262	3980	4315	4918

Table S1. The ratios of CFO and SFO measured by EDX, Mr, Ms and Hc of SFO-CFO samples with different ratios.

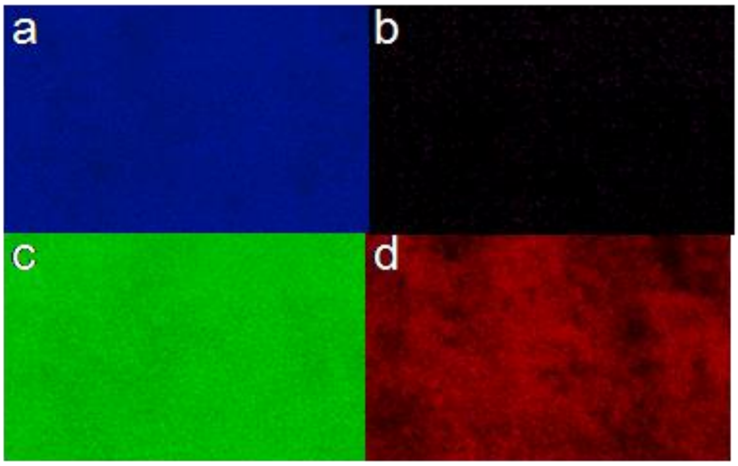

Figure S1. The EDX mapping of SFO-CFO nanocomposites with a ratio of 0.3:1. a. Co; b. Sr; c. Fe, d. O elements.

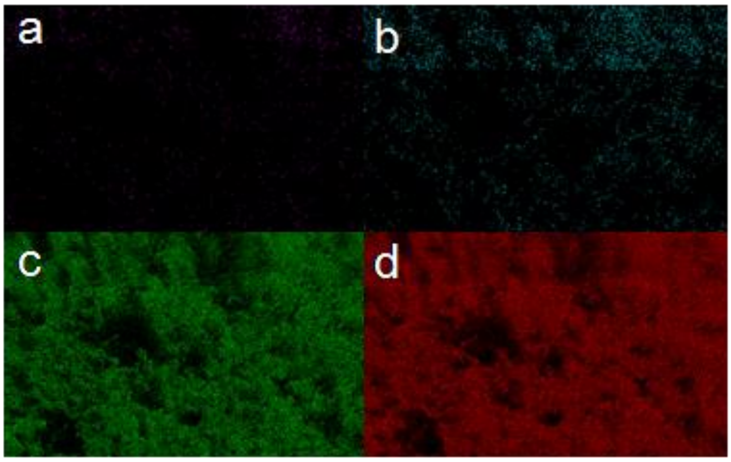

Figure S2. The EDX mapping of SFO-CFO nanocomposites with a ratio of 10:1. a. Co; b. Sr; c. Fe, d. O elements.

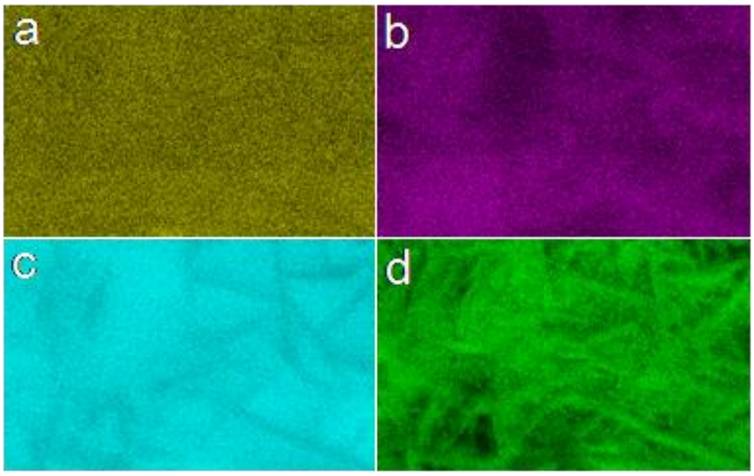

Figure S3. The EDX mapping of SFO-CFO nanocomposites with a ratio of 40:1. a. Co; b. Sr; c. Fe, d. O elements.

The SFO-CFO nanocomposites show the homogeneous structure which can be used to identify the composites prepared by chemical synthesis method.

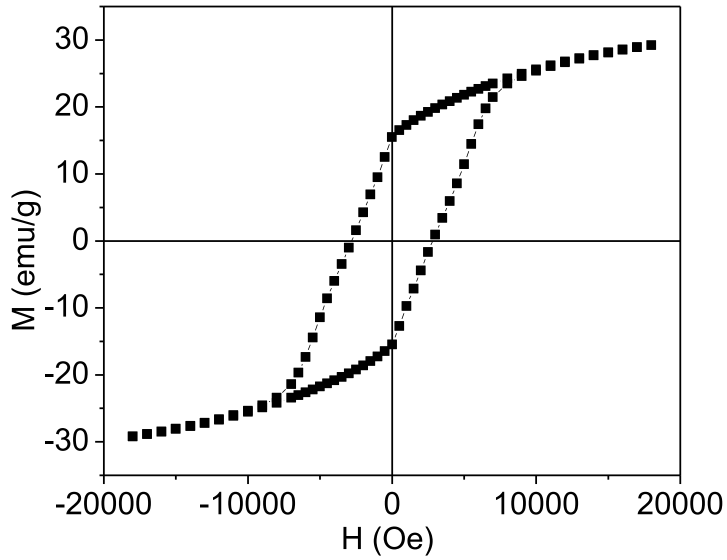

Figure S4. The M-H loop of the mixture between the CFO and SFO nanoparticles, exhibiting the magnetic decoupling behavior.

Decoupling can be observed in figure S4 which indictes the chemical synthesis method is necessary to obtain the CFO-SFO nanocomposite.

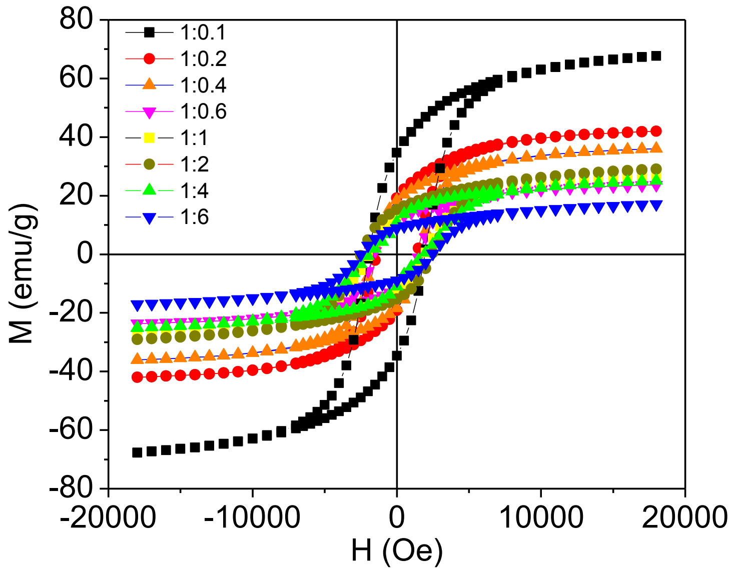

Figure S5. The M-H loops of CFO-SFO nanocomposites with different ratios (CFO:SFO) show the decrease of Ms and the increase of Hc, as increasing SFO due to exchange coupling.

The magnetic behavior indicates the exchange coupling between the two phases.

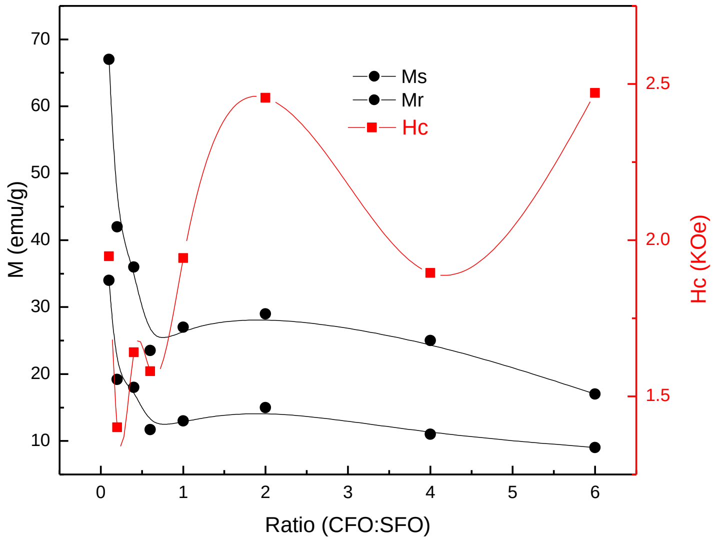

Figure S6. The magnetic characteristics (Ms, Mr and Hc) obtained from the M-H loops of CFO-SFO nanocomposites at different composition ratios.

It can be seen from the figure that the Mr and Ms decrease with the increasing of SFO due to the low Mr and Ms from SFO.

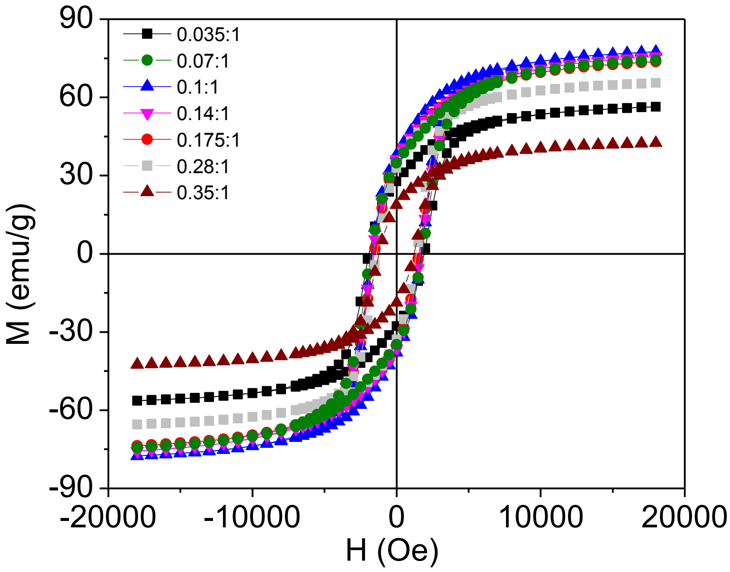

Figure S7. The M-H loops of CFO:SFO nanocomposites with different ratios (SFO:CFO) show the decrease of Ms and the increase of Hc, as increasing SFO due to exchange coupling.

The magnetic behavior indicates the exchange coupling between CFO and SFO.

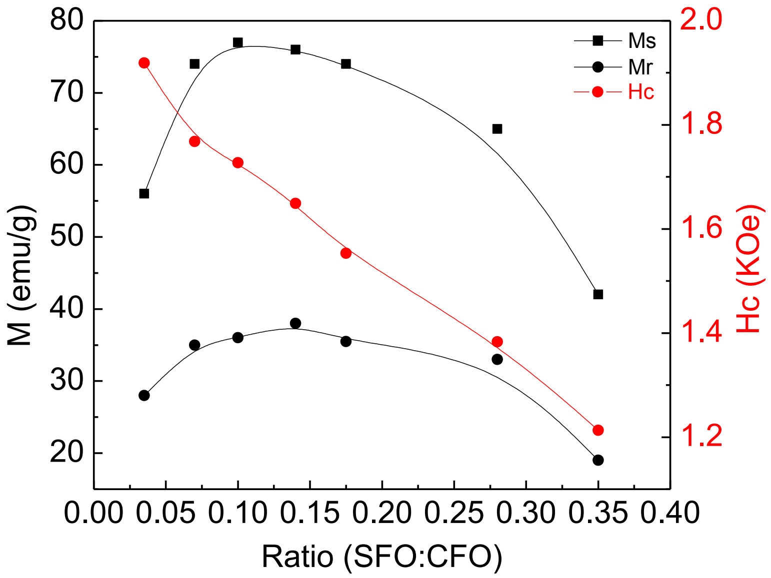

Figure S8. The magnetic characteristics (Ms, Mr and Hc) obtained from the M-H loops of CFO:SFO nanocomposites at different composition ratios.

The decrease of Mr and Ms and the increase of Hc shows the optimum magnetic performance.

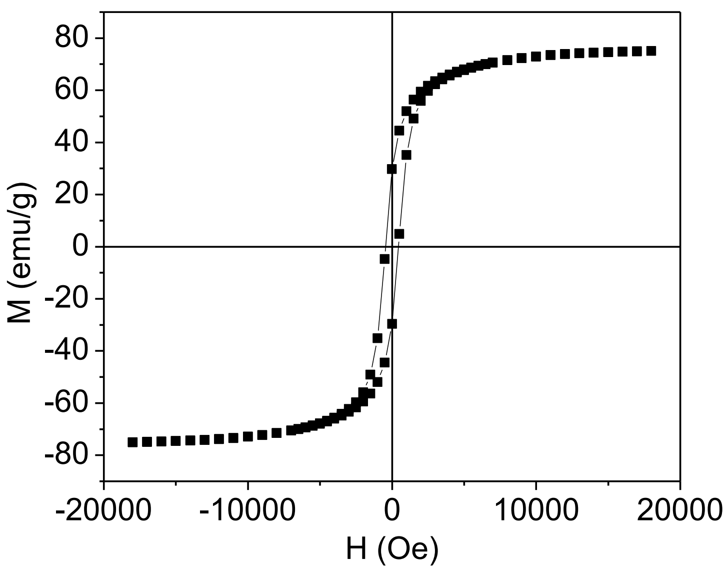

Figure S9. The M-H loop of the sample prepared by annealing the mixture of $Fe(acac)_3$ and Sr $(acac)_2$ at 1000 ^oC for 4h.

The result confirms the chemical synthesis procedure necessary to prepare SFO nanoparticles.