

Supporting Information:

Interplay between local structure and magnetic properties
of graded exchange-coupled Co@FePt nanocomposite films

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Supplementary figures

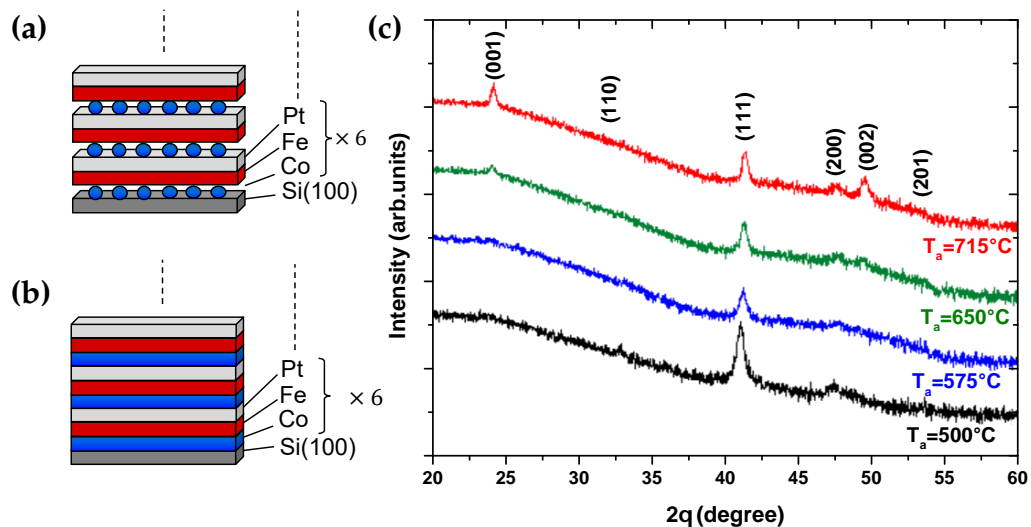


Figure S 1: **(a)** Schematic views of a NC sample and a **(b)** NF sample. **(c)** X-ray diffraction pattern ($\lambda = 1.5406 \text{ \AA}$) of a FePt sample annealed for 20 min at different temperatures. The (001), (200) and (002) peaks, indicators of the $L1_0$ phase, appear at temperature greater than 650°C . One can see that the 715°C annealing spectrum presents a certain c -axis texture as the (001) peak is greater than the (110) one which is just absent (while the calculated intensities ratio (001)/(110) is expected to be 1 for polycrystalline $L1_0$).

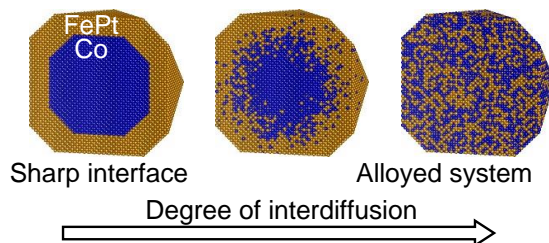


Figure S 2: Schematic views of a Co nano-inclusion in a surrounding FePt matrix as a function of the degree of interdiffusion.

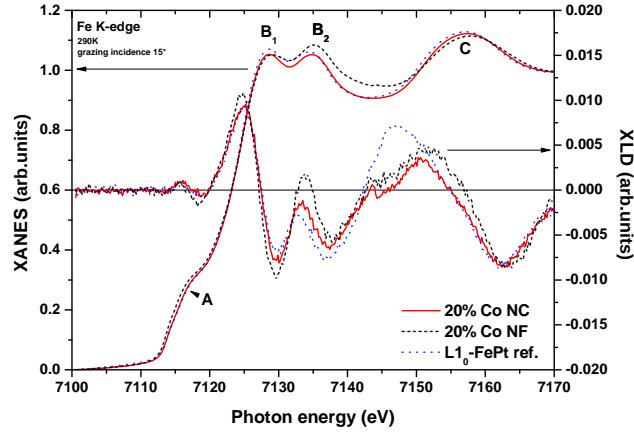


Figure S 3: XANES and XLD signal of 20% Co NC and NF and the L₁₀-FePt ref. sample at the Fe K-edge.

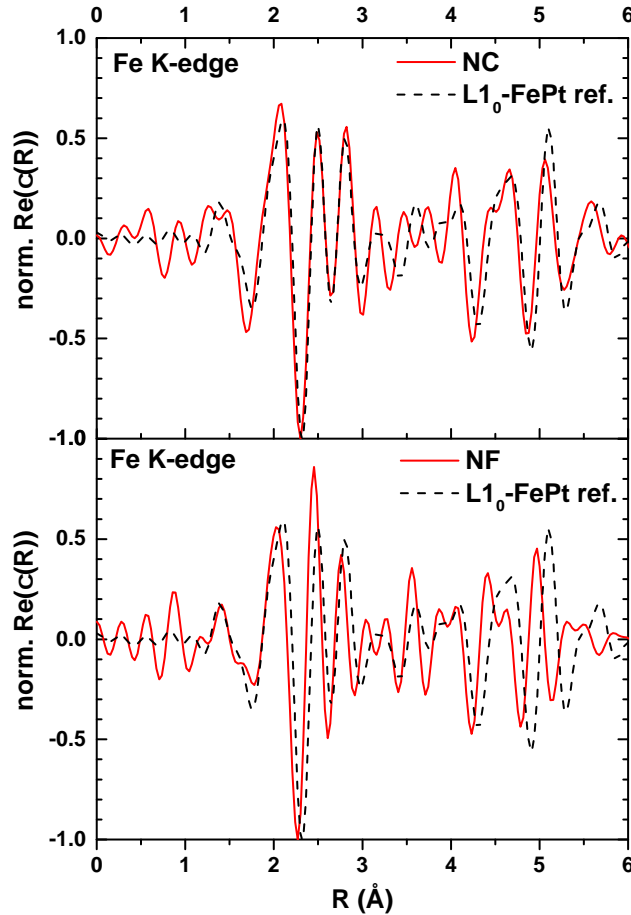


Figure S 4: Real part of the FT of the 30% Co NC and NF samples at the Fe K-edge, along with the FePt reference sample. The NC sample is closer to the reference than the NF.

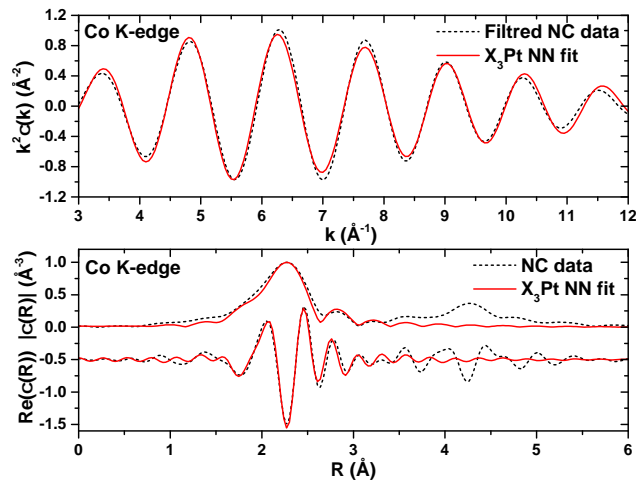


Figure S 5: Weighted EXAFS oscillations, magnitude, and real part of the FT of the 30% Co NC sample at the Co K-edge, along with the X_3Pt fit on the nearest homo and hetero-atomic neighbours (NN).

EXAFS detailed results

Table S 1: EXAFS parameters found for the L1₀-FePt reference prepared.

Edge	Bound	N _{exp}	N _{bulk} L1 ₀ -FePt	R _{exp} (Å)	R _{bulk} L1 ₀ -FePt (Å)	σ ² (Å ²)	ΔE (eV)
Fe	Fe-Pt	7.1	8	2.67	2.67	0.007	4.44
Fe	Fe-Fe	3.6	4	2.72	2.72	0.015	4.44
Pt	Pt-Fe	7.4	8	2.67	2.67	0.006	6.85
Pt	Pt-Pt	3.7	4	2.72	2.72	0.003	6.85

Table S 2: EXAFS parameters found for the 30% Co NC.

Edge	Bound	N _{exp}	N _{bulk} L1 ₀ -FePt	R _{exp} (Å)	R _{bulk} L1 ₀ -FePt (Å)	σ ² (Å ²)	ΔE (eV)
Fe	Fe-Pt	6.1	8	2.67	2.67	0.004	5.70
Fe	Fe-Fe	3.0	4	2.72	2.72	0.010	5.70
Pt	Pt-Fe	7.3	8	2.67	2.67	0.007	7.05
Pt	Pt-Pt	3.6	4	2.72	2.72	0.004	7.05

Edge	Bound	N _{exp}	N _{bulk} X ₃ Pt	R _{exp} (Å)	R _{bulk} X ₃ Pt (Å)	σ ² (Å ²)	ΔE (eV)
Co	Co-Co	7.6	8	2.59	2.59	0.012	5.47
Co	Co-Pt	3.8	4	2.59	2.59	0.005	5.47

Table S 3: EXAFS parameters found for the 30% Co NF ($X = Co, Fe$).

Edge	Bound	N_{exp}	N_{bulk} $X_3\text{Pt}$	R_{exp} (\AA)	R_{bulk} $X_3\text{Pt}$ (\AA)	σ^2 (\AA^2)	ΔE (eV)
Fe	Fe-Pt	3.8	4	2.63	2.59	0.004	6.33
Fe	Fe-Co	3.8	4	2.63	2.59	0.017	6.33
Fe	Pt-Fe	3.8	4	2.63	2.59	0.017	6.33
Pt	Pt-Pt	3.6	4	2.59	2.59	0.004	7.05
Pt	Pt-Pt	3.6	4	2.59	2.59	0.004	7.05

Edge	Bound	N_{exp}	N_{bulk} $X_3\text{Pt}$	R_{exp} (\AA)	R_{bulk} $X_3\text{Pt}$ (\AA)	σ^2 (\AA^2)	ΔE (eV)
Co	Co-Co	9.0	8	2.59	2.59	0.006	5.31
Co	Co-Pt	4.5	4	2.59	2.59	0.011	5.31

Table S 4: EXAFS parameters found for the 30% Co NC for the nearest neighbours (between 1.5 and 3.0 \AA) with the coordination number free but still keeping $N_{Co,Fe} + N_{Pt} = 12$ ($X = Co, Fe$). We obtained $N_{Co-Pt} = 3.9$ so as there is as much Fe as Pt, $N_{Co-matrix} = 2 \times 3.9 = 7.8$. Thus $N_{Co-Pt} = 12 - N_{Co-matrix} = 4.2$.

Edge	Bound	N_{exp}	N_{bulk} $X_3\text{Pt}$	R_{exp} (\AA)	R_{bulk} $X_3\text{Pt}$ (\AA)	σ^2 (\AA^2)	ΔE (eV)
Co	Co-X	8.1	8	2.59	2.59	0.013	3.92
Co	Co-Pt	3.9	4	2.60	2.59	0.005	3.92

Simulation results

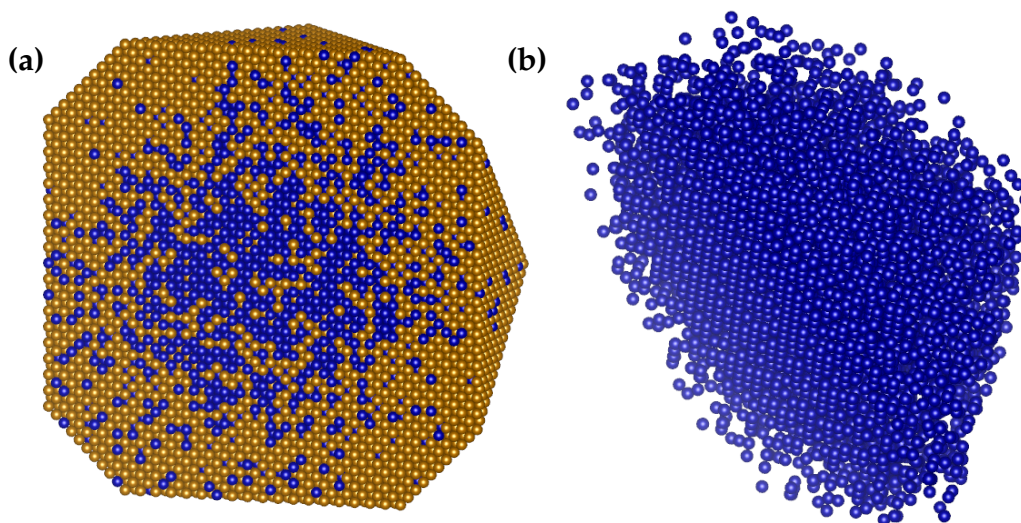


Figure S 6: **(a)** Cut of a diffused cluster after enough iteration to obtain a Co-Co coordination number equal to the one given by the EXAFS fit ($N_{Co-Co} = 4.2$). The Co atoms are in blue, and the matrix atom (Fe+Pt) in orange. **(b)** Cut of the diffused cluster (slightly rotated) showing only the Co atoms.

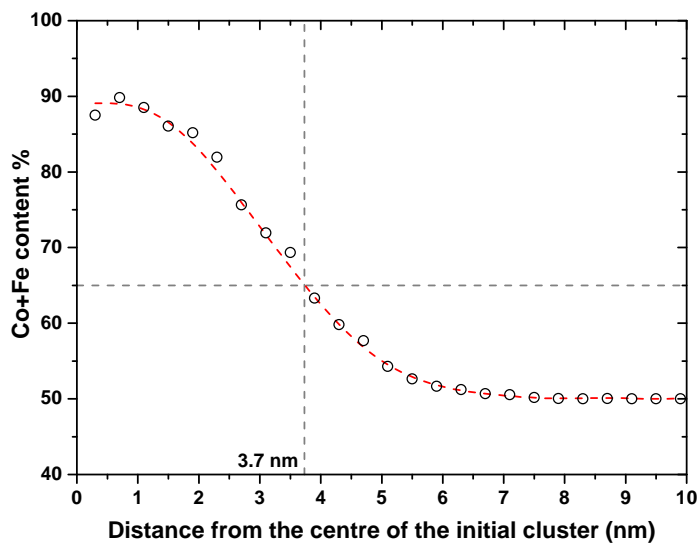


Figure S 7: Co+Fe profile from the cluster diffusion model obtained for $N_{Co-Co} = 4.2$.

EXAFS fit

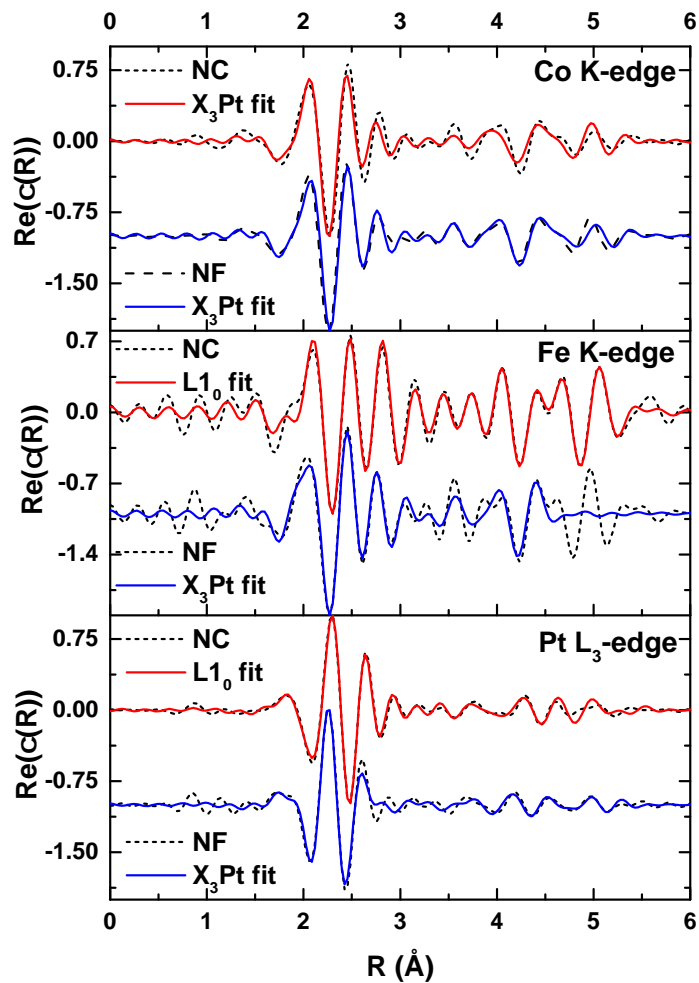


Figure S 8: Real part of the FT for 30% Co NC and NF with their respective best fits at each edge.