Supporting Information

Eutectic melt crystallization of $L1_0$-FePt

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Platinum(II) acetylacetonate(97%, Sigma- Aldrich), Iron(II) acetylacetonate(99.95%, Sigma- Aldrich), and Lithium Chloride/ Pottasium Chloride(LiCl 50 wt%, BTC) were used as obtained, no further treatment were applied before use. A mixture with a proper amount of $Fe(acac)_2$, $Pt(acac)_2$, and LiCl-KCl powders was mixed by hand vigorously for 10 min in an agate mortal using a pestle. To ensure enough amount of LiCl-KCl was used, the weight ratio of the eutectic salts and the metal precursor was 10:1. Then, the mixture powder was put into a quartz tube furnace with an Al_2O_3 crucible for heat treatment. The heating rate was 10 K/min and the reaction time was 3 hours. The whole process of the reaction was protected under the forming gas with 93% N_2 and 7% H_2. After annealing, the LiCl-KCl eutectic salts were removed by washing the powder mixture with deionized water. The final FePt powder was then collected and dried with a low-temperature drying oven. Later the product was brought out from the drying oven and dispersed in hexane. The structure information was gathered with Optical Microscope, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and powder X-ray Diffraction (XRD). The magnetic properties were characterized by a Physical Property Measurement System (PPMS) with up to 7T magnetic field under room temperature (300K).

As demonstrated in Figure 3, both eutectic method and organic solution method yielded the same value of saturation magnetization for 10 wt.% cobalt. However, a kink occurs for the eutectic method. The coercivity of the eutectic method coated sample was damaged by this kink; hence a small value of coercivity was obtained as 6 kOe. In the other hands, the sample prepared using conventional organic solvent synthesis method has a coercivity of 13 kOe. Therefore, the coating process was performed using traditional organic solvent liquid phase synthesis method. The doped cobalt in the product served as a semi-hard magnetic phase which helped to increase the saturation magnetization value.

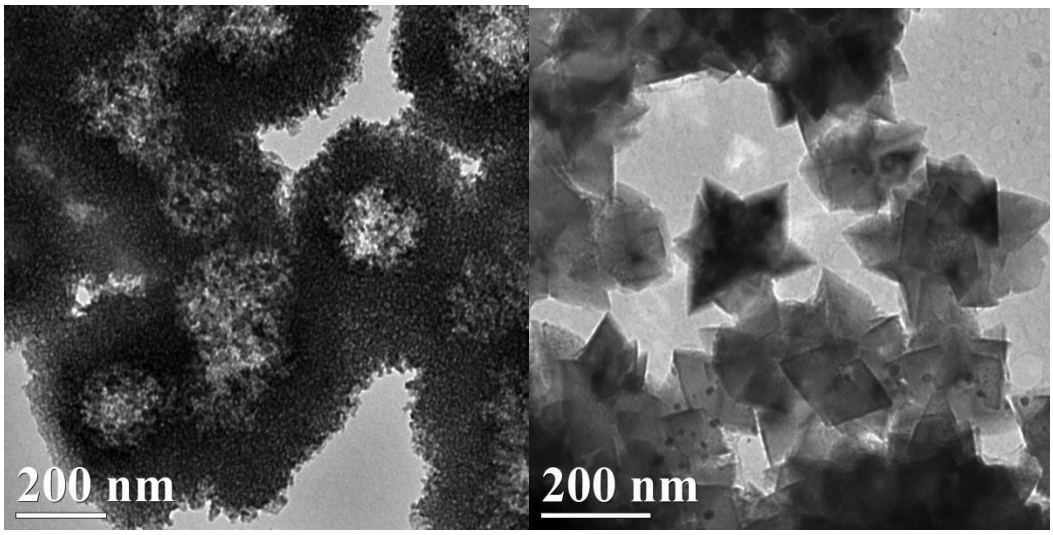

Figure 1. Residual carbon in FePt powder product (Left), and residual eutectic salts (Right).

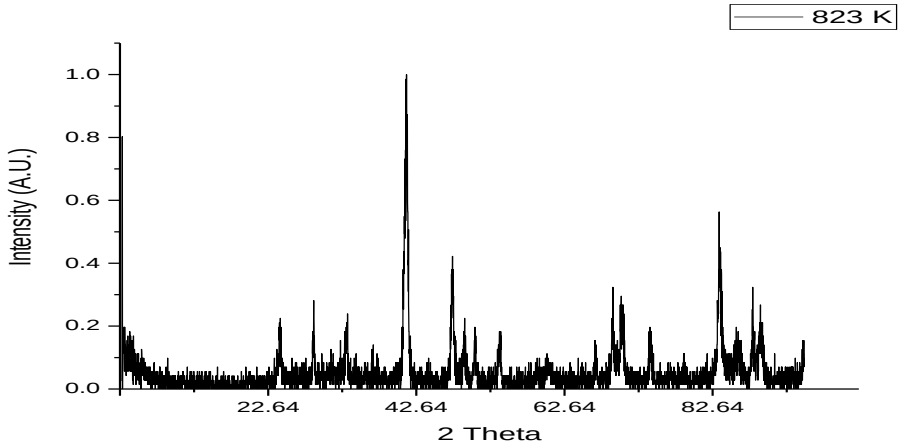

Figure 2. XRD data for 823 K reacted FePt sample.

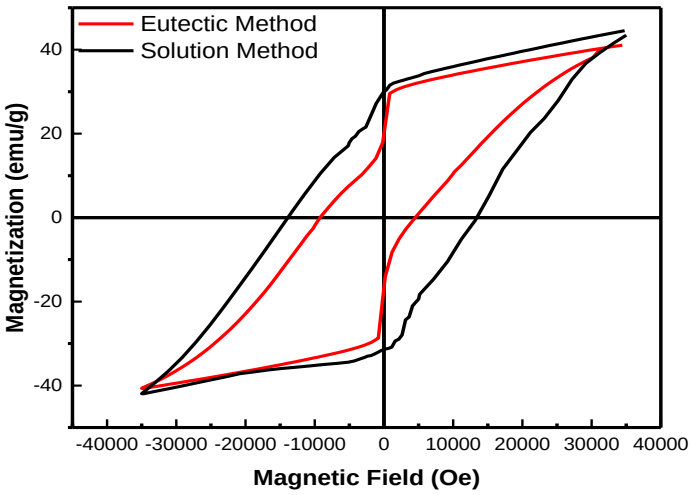

Figure 3. Comparison of hysteresis loop for different coating method

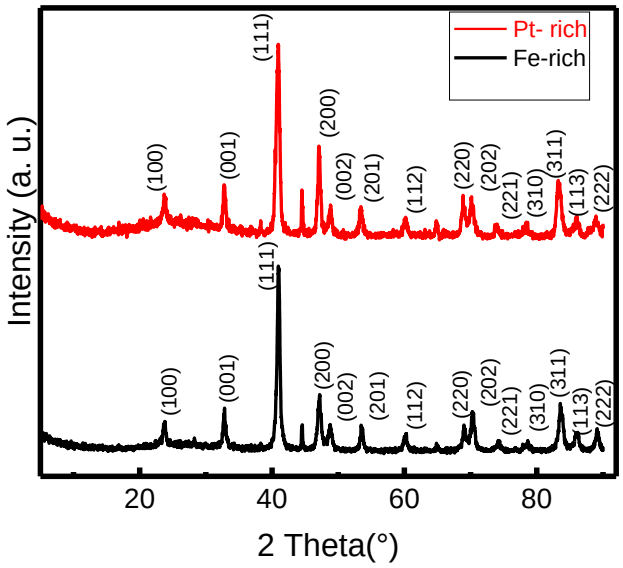

Figure 4. XRD spectrum for 1Fe:2Pt sample and 2Fe:1Pt sample synthesized at 1023K.

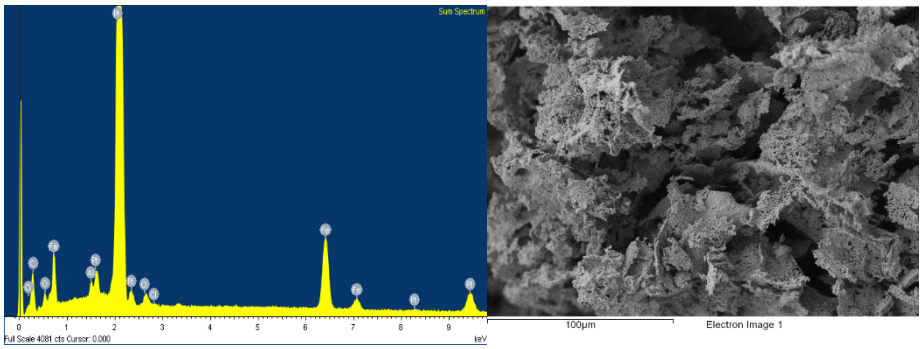

Figure 5. Energy dispersive X-ray spectra and SEM image for 1:1 Fe to Pt ratio FePt product

Element	App Conc.	Intensity Corrn.	Weight%	Weight% Sigma	Atomic%
C K	10.98	0.5943	8.71	0.30	43.70
O K	4.64	0.9308	2.35	0.15	8.85
Al K	1.46	1.0697	0.64	0.04	1.44
Cl K	1.31	0.8008	0.77	0.06	1.31
Fe L	28.90	0.5940	22.92	0.55	24.74
Pt M	119.47	0.8709	64.62	0.53	19.97
Totals			100.00		

Table 1. EDS quantity analysis for 1073 K FePt powder.

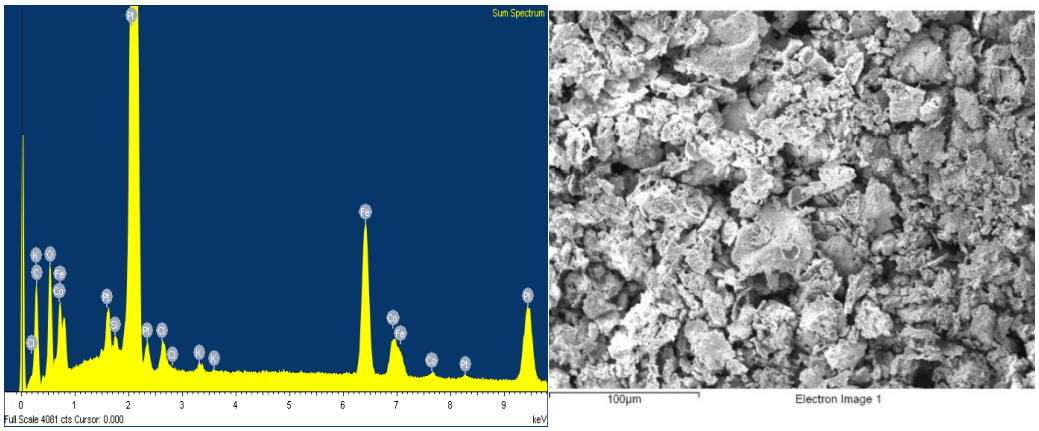

Figure 6. Energy dispersive X-ray spectra and SEM image for 15% coated Cobalt FePt product.

Element	Weight %	Atomic %
C K	12.17	43.56
O K	8.83	23.72
Si K	0.28	0.43
Cl K	0.84	1.01
K K	0.33	0.36
Fe L	15.69	12.08
Co L	10.23	7.46
Pt M	51.63	11.38
Totals	100.00	

Table 2. EDS quantity analysis for 15% wt. % coated Cobalt

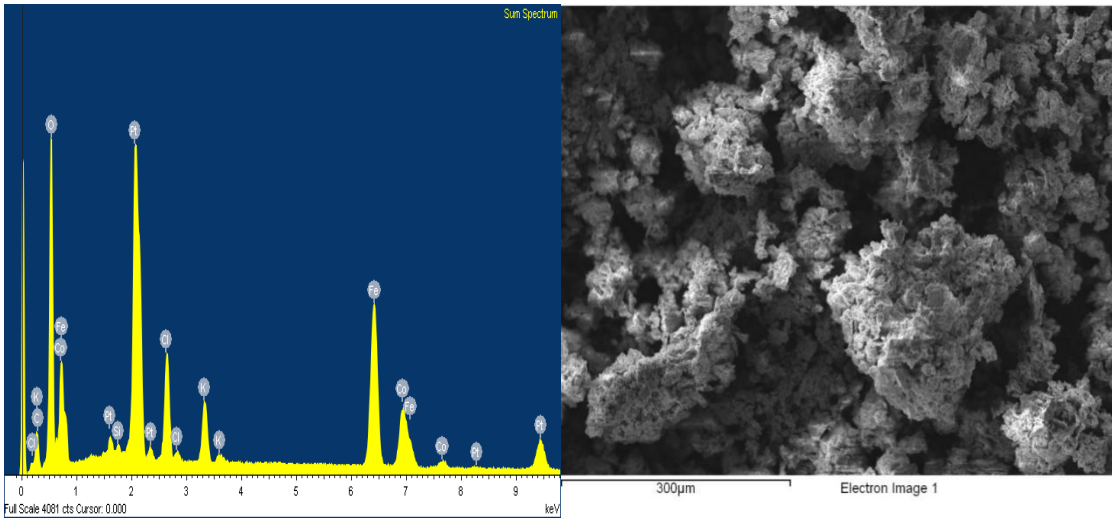

Figure 7. Energy dispersive X-ray spectra and SEM image for 25% coated Cobalt

Element	Weight %	Atomic %
C K	5.04	14.69
O K	22.44	49.13
Si K	0.20	0.24
Cl K	3.68	3.64
K K	2.49	2.23
Fe L	28.58	17.93
Co L	13.00	7.72
Pt M	24.58	4.41
Totals	100.00	

Table 3. EDS quantity analysis for 25% wt.% coated Cobalt