Electronic Supplementary Information:

Sinter-free phase conversion and scanning transmission electron microscopy of FePt nanoparticle monolayers

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Representative transmission electron microscopy images of the as-synthesized nanoparticles with selected-area electron diffraction:

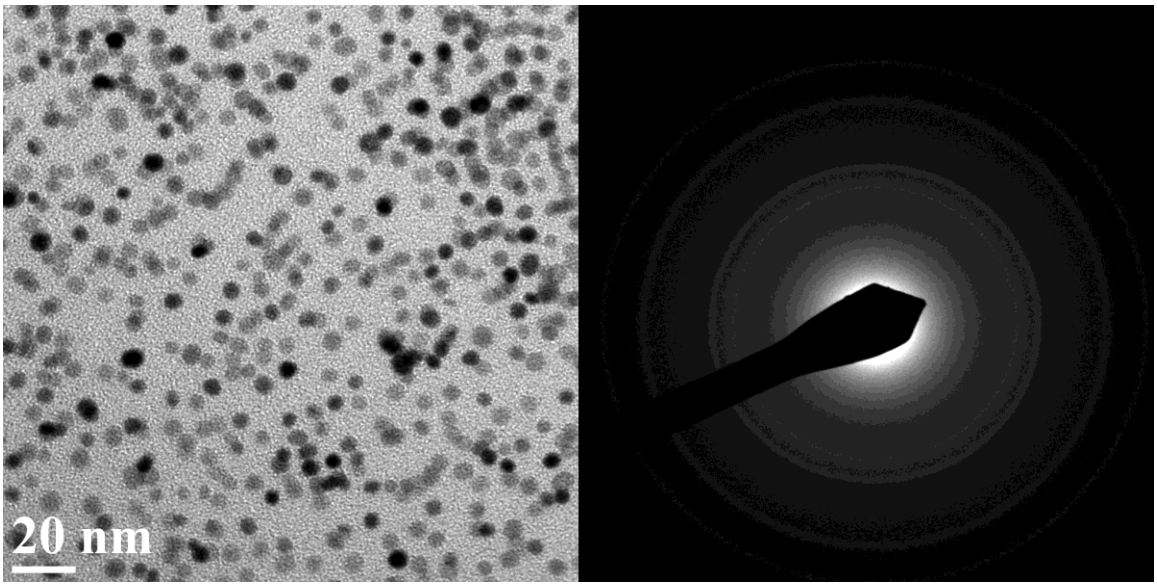

Figure S-1. Representative TEM image of 4.2 nm FePt nanoparticles.

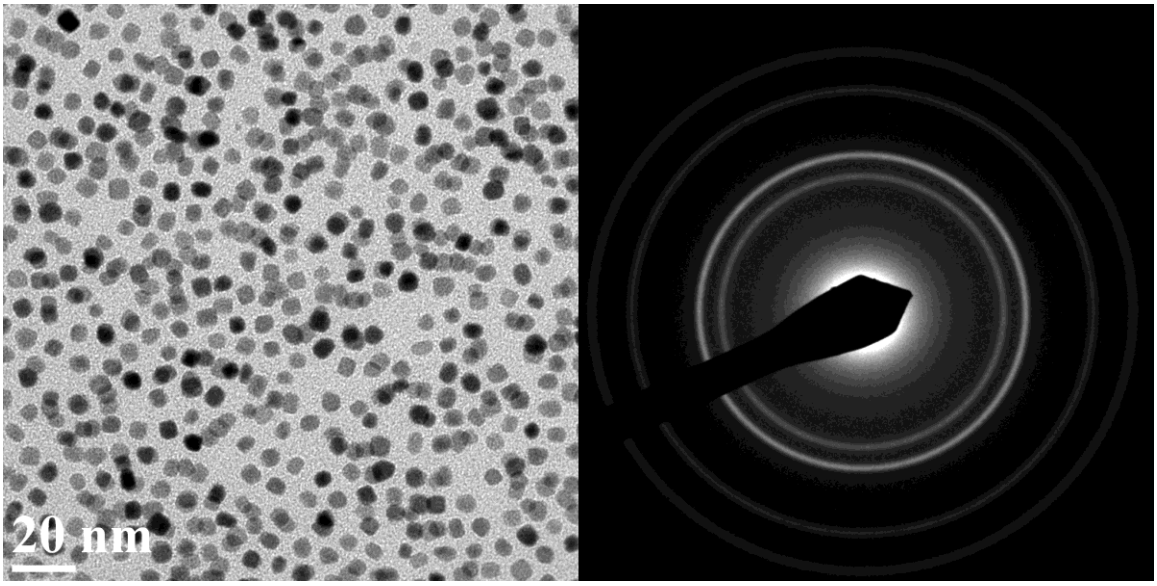

Figure S-2. Representative TEM image of 4.9 nm FePt nanoparticles.

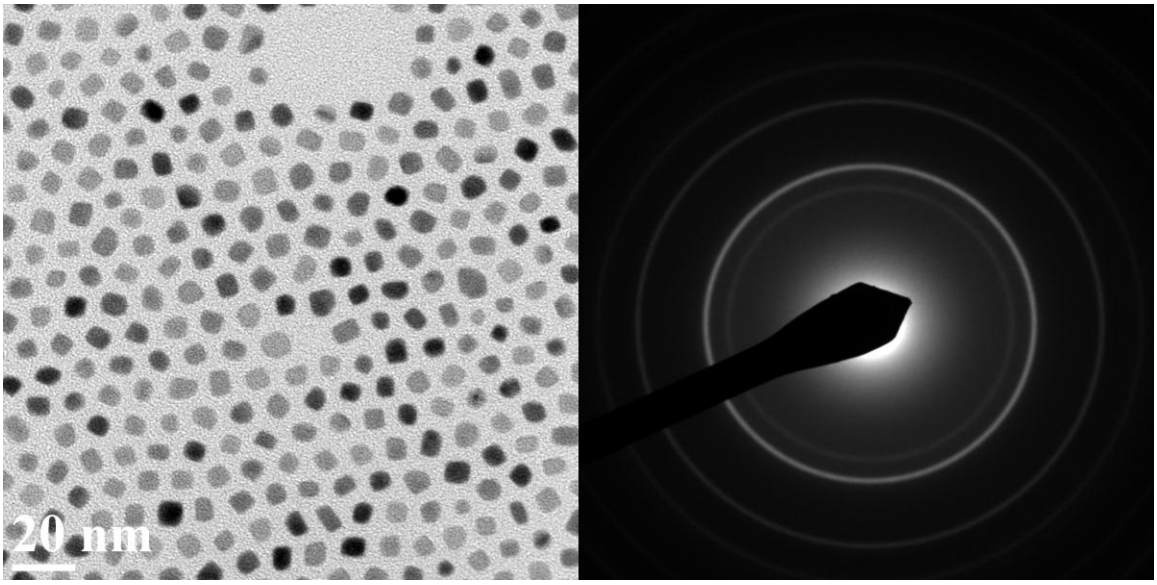

Figure S-3. Representative TEM image of 5.9 nm FePt nanoparticles.

Energy dispersive X-ray spectra:

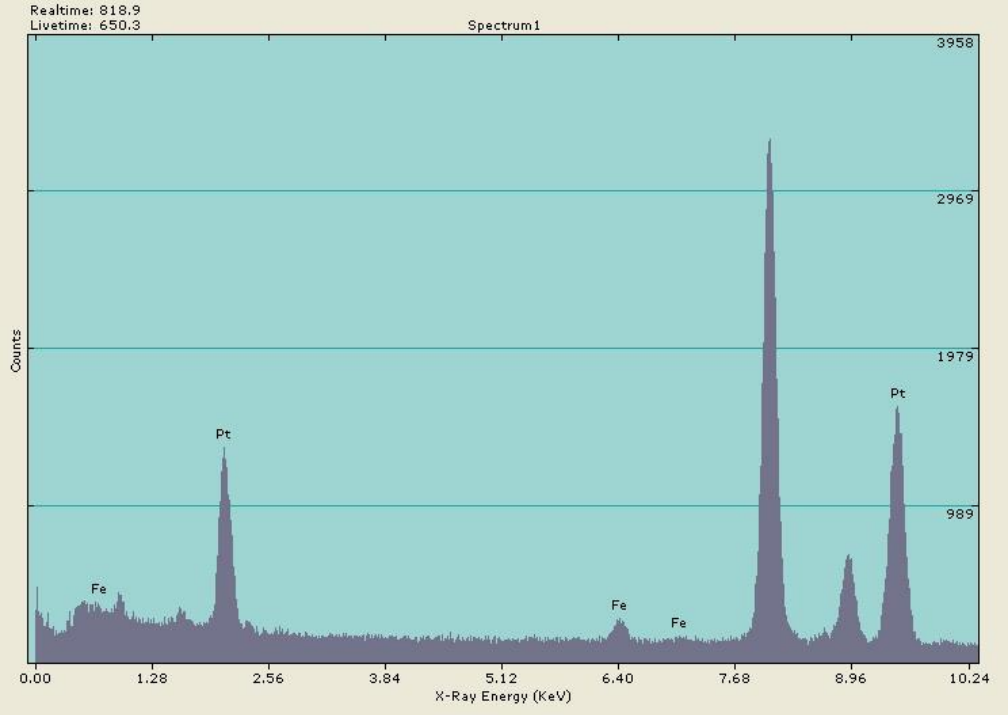

Figure S-4. EDS spectrum for 4.2 nm FePt nanoparticles.

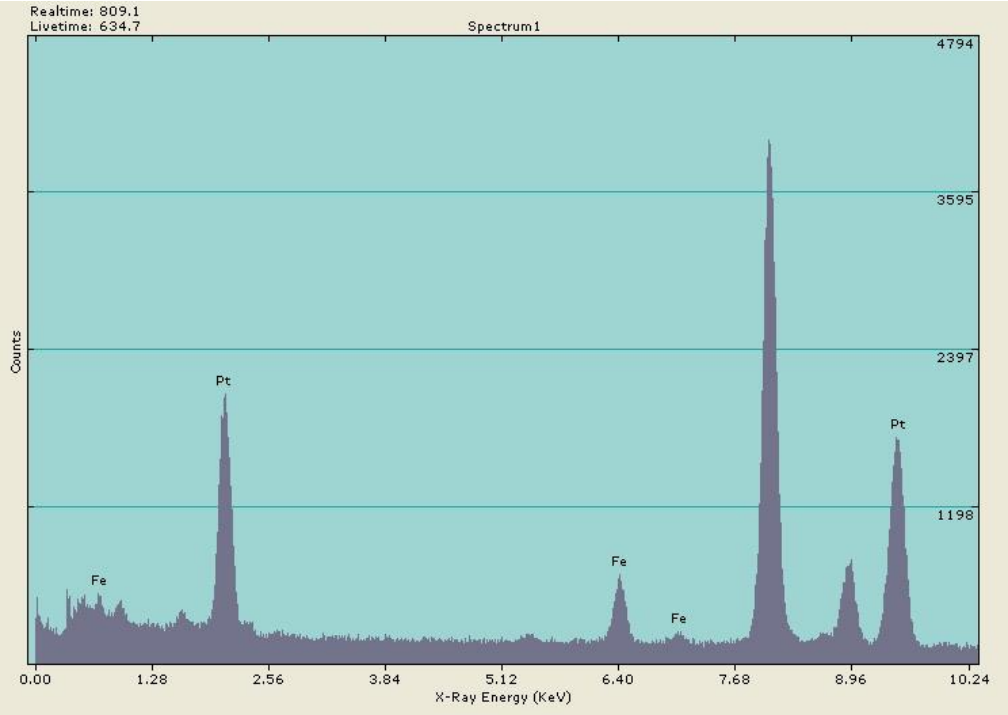

Figure S-5. EDS spectrum for 4.9 nm FePt nanoparticles.

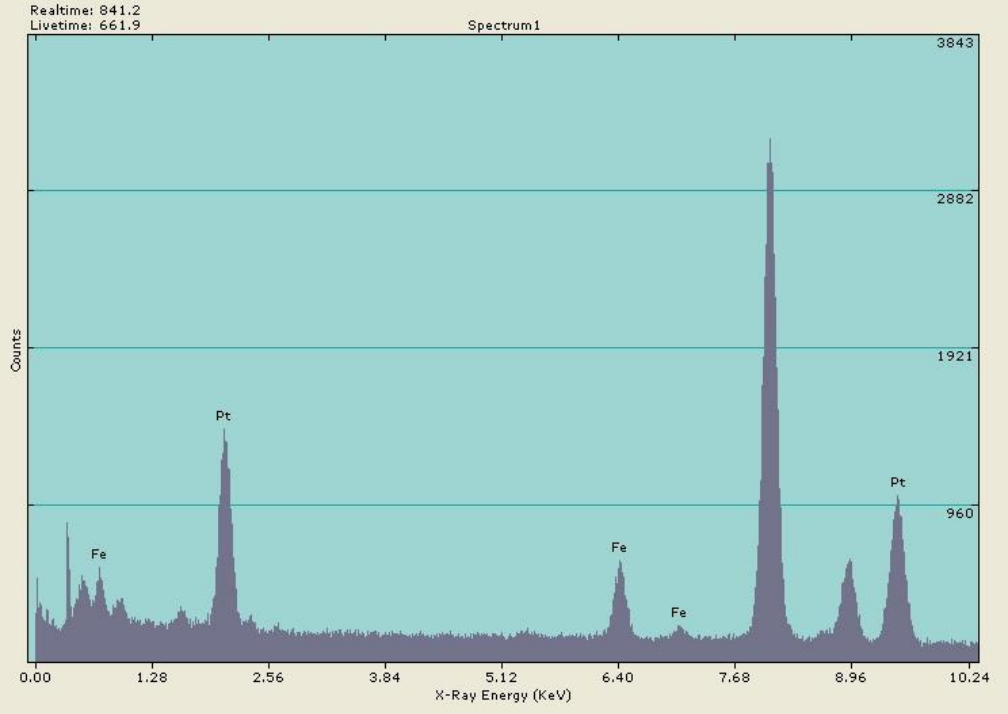

Figure S-6. EDS spectrum for 5.9 nm FePt nanoparticles.

Additional TEM image:

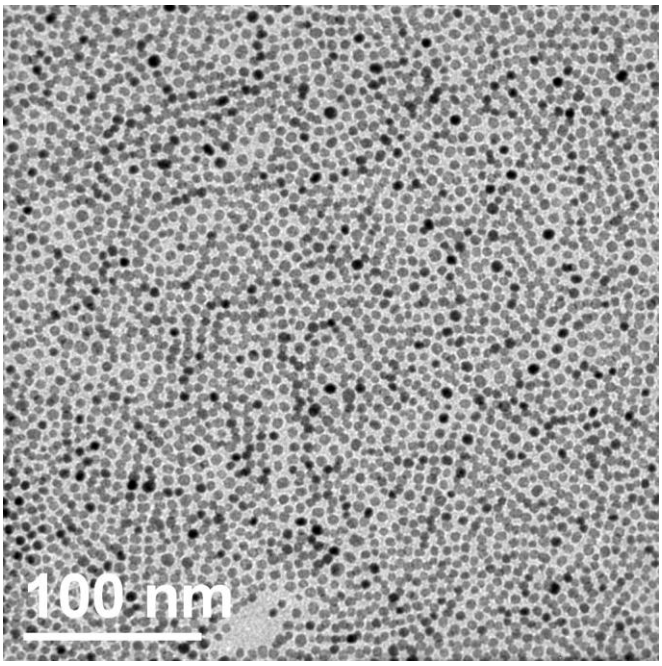

Figure S-7. TEM image of a spin cast array of a partial multilayer of 4.2 nm diameter FePt nanoparticles.

Additional Z-contrast STEM images:

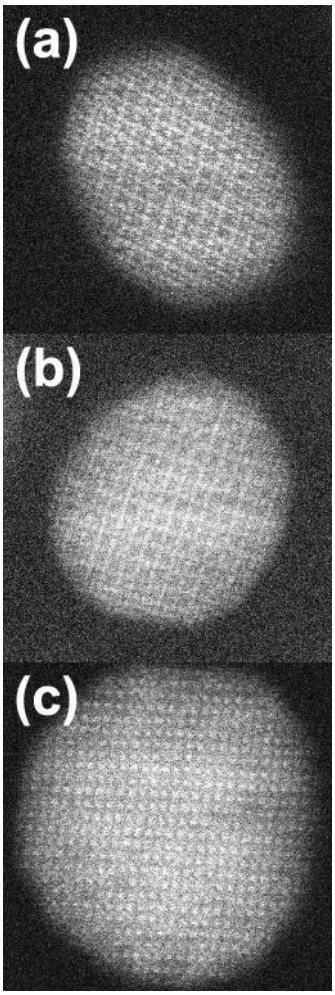

Figure S-8. HAADF-STEM images used in Figure 6, before noise filtering.

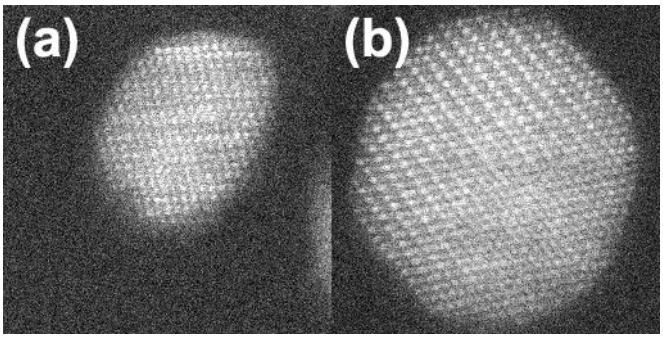

Figure S-9. HAADF-STEM images used in Figure 7, before noise filtering.

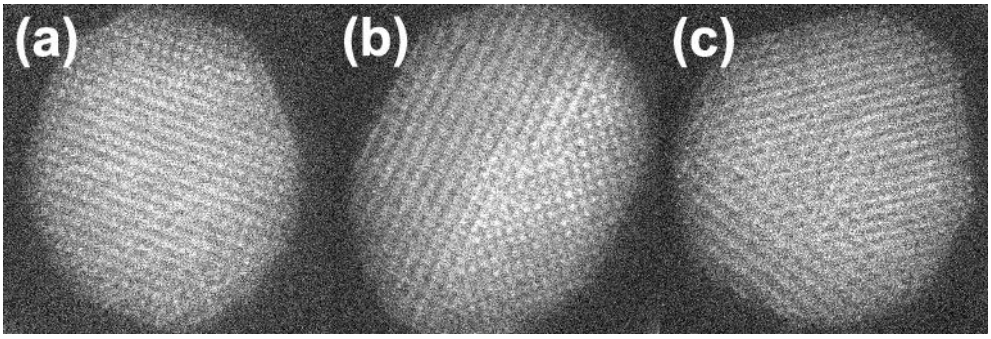

Figure S-10. HAADF-STEM images used in Figure 8, before noise filtering.

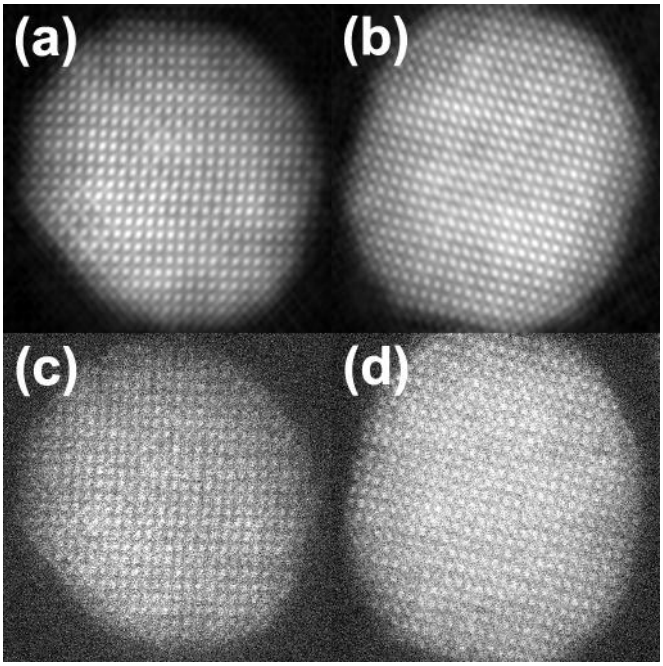

Figure S-11. (a-b) Filtered and (c-d) the original, unfiltered HAADF-STEM images showing the presence of the $FePt_3$ phase forming on the edges of the nanoparticles.

Details of Z-contrast STEM image simulation:

Images were simulated using QSTEM, a program written by Chistoph Koch that is based in Matlab and uses a multislice algorithm to compute the wave function at the exit surface of the crystal. The .cfg files used to generate the models employed in the simulation are as follows:

FePt $L1_0$:

```
Number of particles = 4
A = 1.0 Angstrom (basic length-scale)
H0(1,1) = 3.852 A  #
```

```
H0(1,2) = 0 A
H0(1,3) = 0 A
H0(2,1) = 0 A #
H0(2,2) = 3.822 A   #
H0(2,3) = 0 A
H0(3,1) = 0 A
H0(3,2) = 0 A
H0(3,3) = 3.713 A #
.NO_VELOCITY.
entry_count = 5
56
Fe
 0.50    0.00    0.50 0.35 1
 0.00    0.50    0.50 0.35 1
195
Pt
 0.00    0.00    0.00 0.37 1
 0.50    0.50    0.00 0.37 1
```

FePt $L1_2$:

```
Number of particles = 4
A = 1.0 Angstrom (basic length-scale)
H0(1,1) = 3.877 A  #
H0(1,2) = 0 A
H0(1,3) = 0 A
H0(2,1) = 0 A #
H0(2,2) = 3.877 A   #
H0(2,3) = 0 A
H0(3,1) = 0 A
H0(3,2) = 0 A
H0(3,3) = 3.877 A #
.NO_VELOCITY.
entry_count = 5
56
Fe
 0.50    0.00    0.50 0.35 1
195
Pt
 0.00    0.00    0.00 0.37 1
 0.50    0.50    0.00 0.37 1
 0.00    0.50    0.50 0.37 1
```

The lattice parameters are from JCPDS files (43-1359 and 29-716), and the Debye-Waller factors from the literature.[1] A 10 × 10 × 15 unit cell box was simulated with zero tilt in all directions. A scan window of 15 Å × 15 Å and a scan length of 25 pixels in each direction were chosen. The model was sliced into two horizontal slabs with 30 slices per slab. Microscope parameters were then selected that would *approximately* mimic the experimental setup used on the JEOL 2010F: voltage: 200 kV, defocus: -43.4 mm, Cs: 0.5 mm, temperature: 300 K, Cc: 1.1 mm, convergence angle: 8.5 mrad, dE: 0.8 eV, dwell time: 15.7 μs, and detector inner and outer angles: 60 and 200 mrad, respectively. A total of 30 thermal diffuse scattering (TDS) configurations were averaged to compute the final image that was viewed with an oversampling of 7 and an assumed source

size of 1.3 Å. The final image was from a ~ 3.7 nm thick section, and Poisson (shot) noise was added.

1. Sears, V. F.; Shelley, S. A., Debye-Waller Factor for Elemental Crystals. *Acta Crystallogr. Sect. A* **1991,** *47*, 441-446.