Summer 2007

Synthesis, characterization and application of Pd-Pt bimetallic nanoparticles and carbon nanotubes supported nanocomposites

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Department:

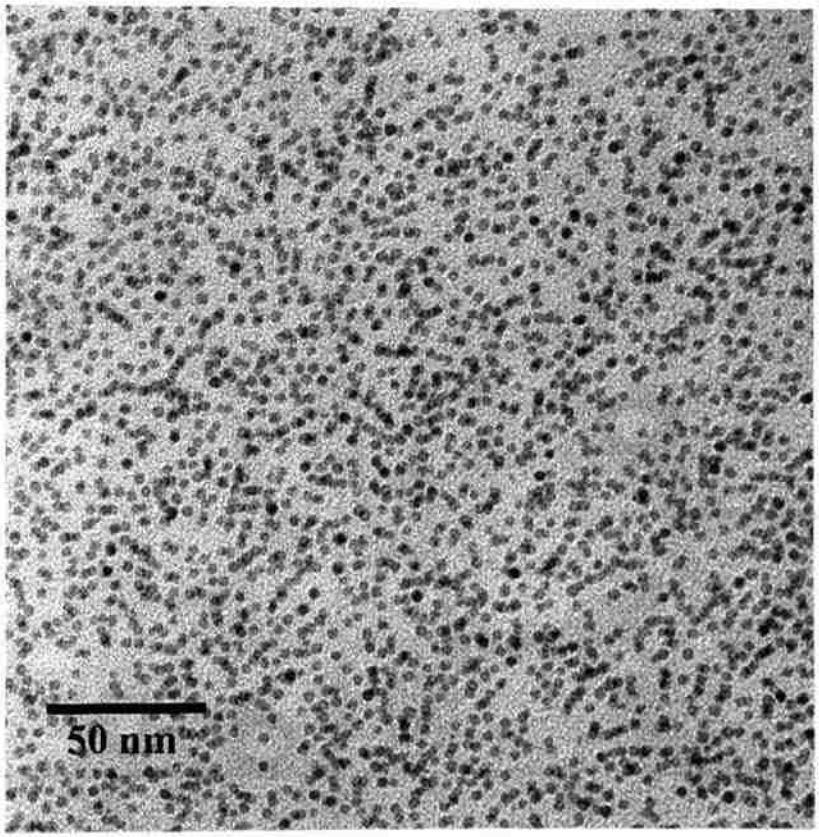


Figure 1. A typical TEM image of the Pd-Pt alloy nanoparticles with an average size of 3.5 nm.

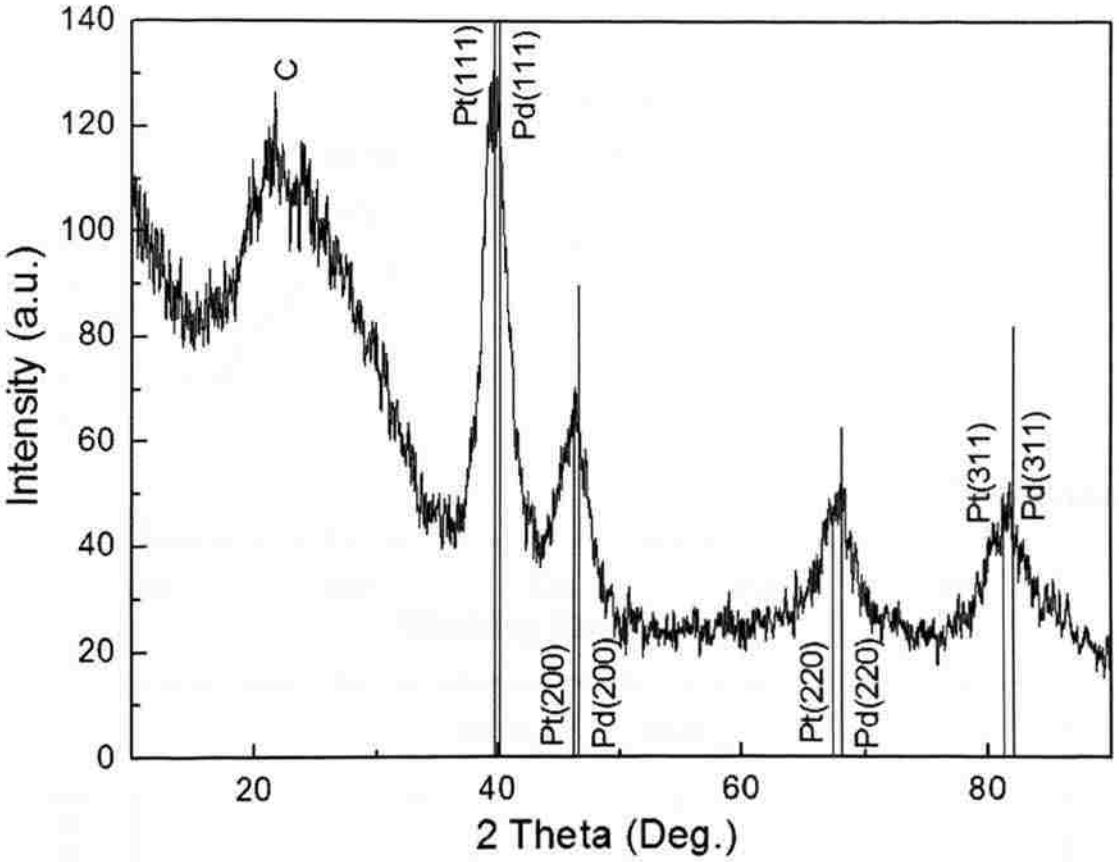


Figure 2. XRD pattern of the synthesized Pd-Pt nanoparticles supported on carbon.

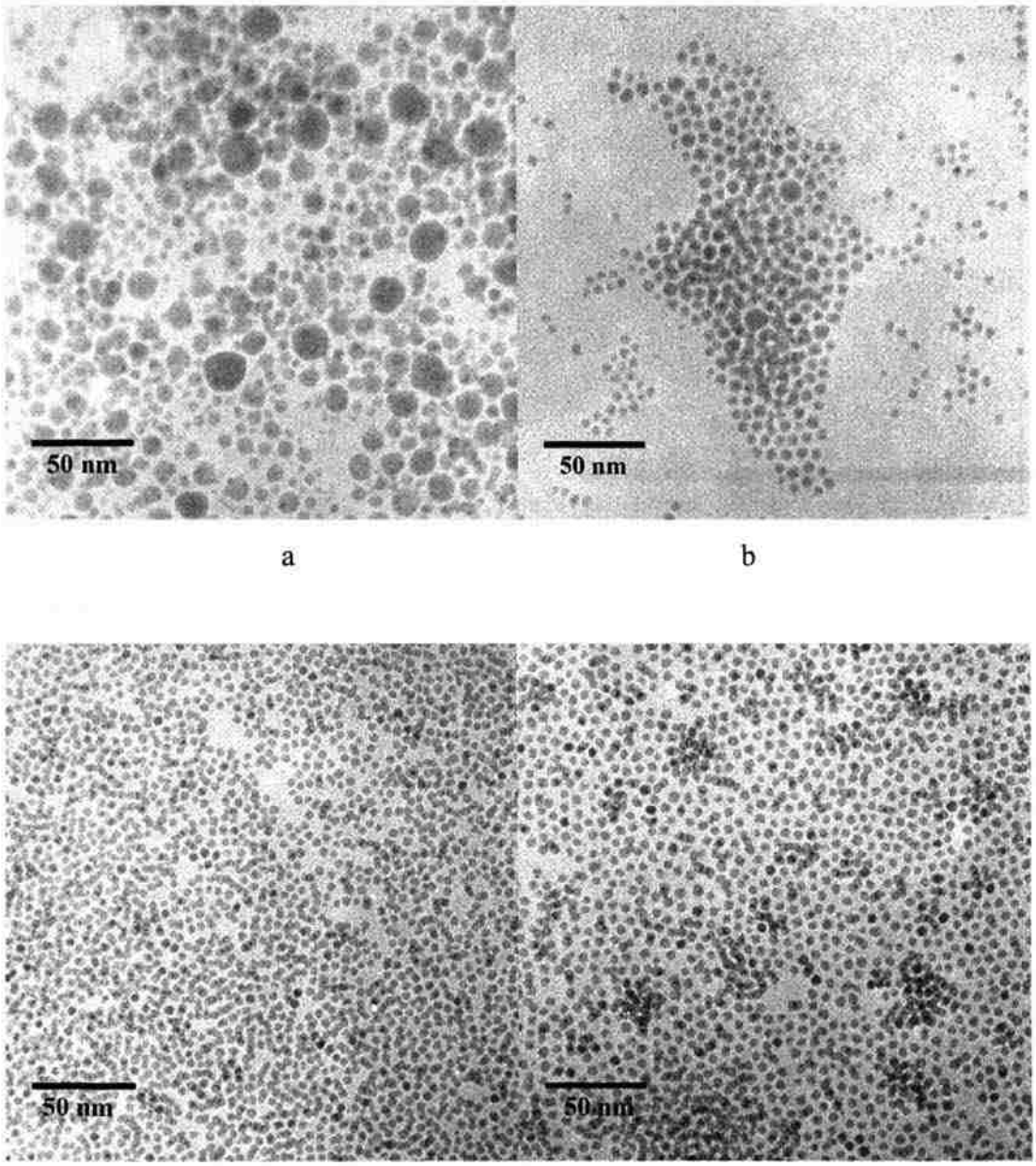
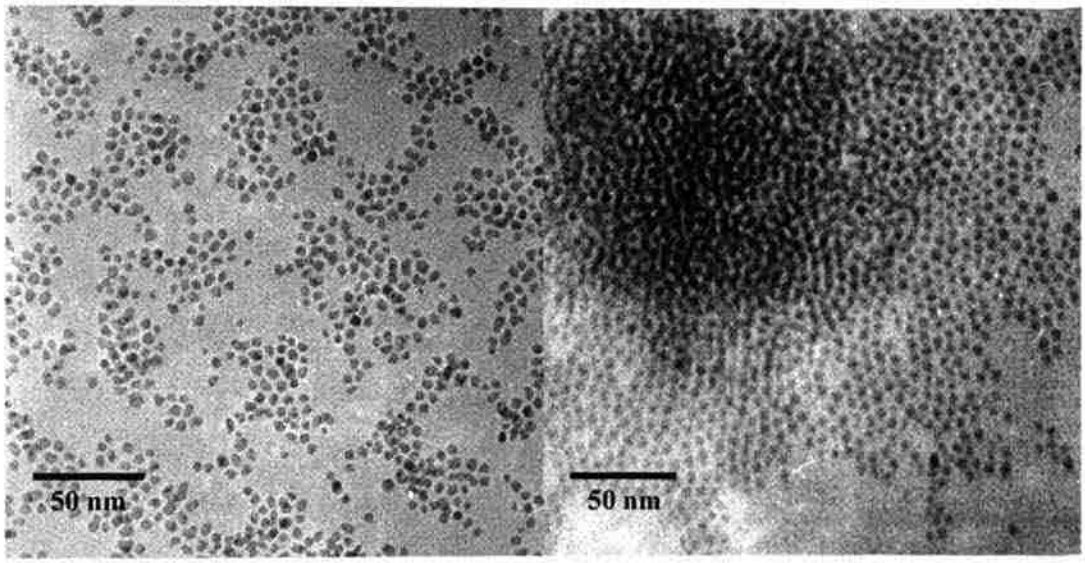


Figure 4. Morphological evolution of the Pd-Pt nanoparticles during the synthesis: (a) – (f) show the nanoparticles collected at 3, 5, 10, 30, 40 and 120 min durations, respectively. The nanoparticle size remained unchanged after 10 min.



e f

Figure 4. Morphological evolution of the Pd-Pt nanoparticles during the synthesis: (a) – (f) show the nanoparticles collected at 3, 5, 10, 30, 40 and 120 min durations, respectively. The nanoparticle size remained unchanged after 10 min. (cont.)

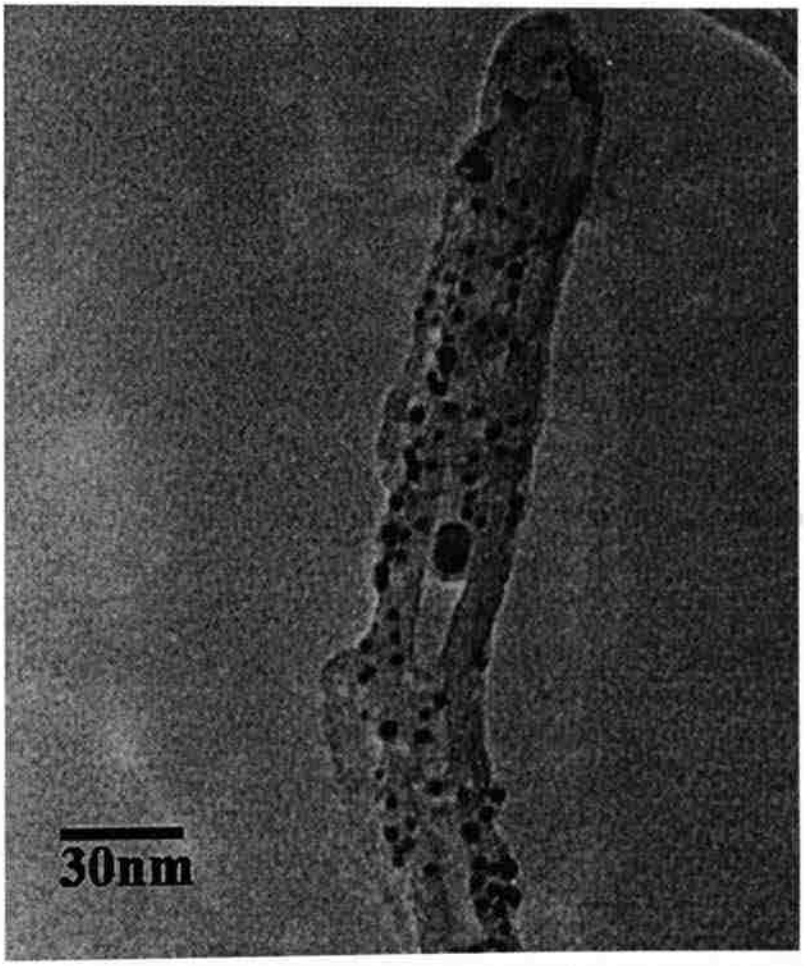


Figure 4. TEM image of sintered PtPd nanoparticles on CNTs heat treated at 300 °C.

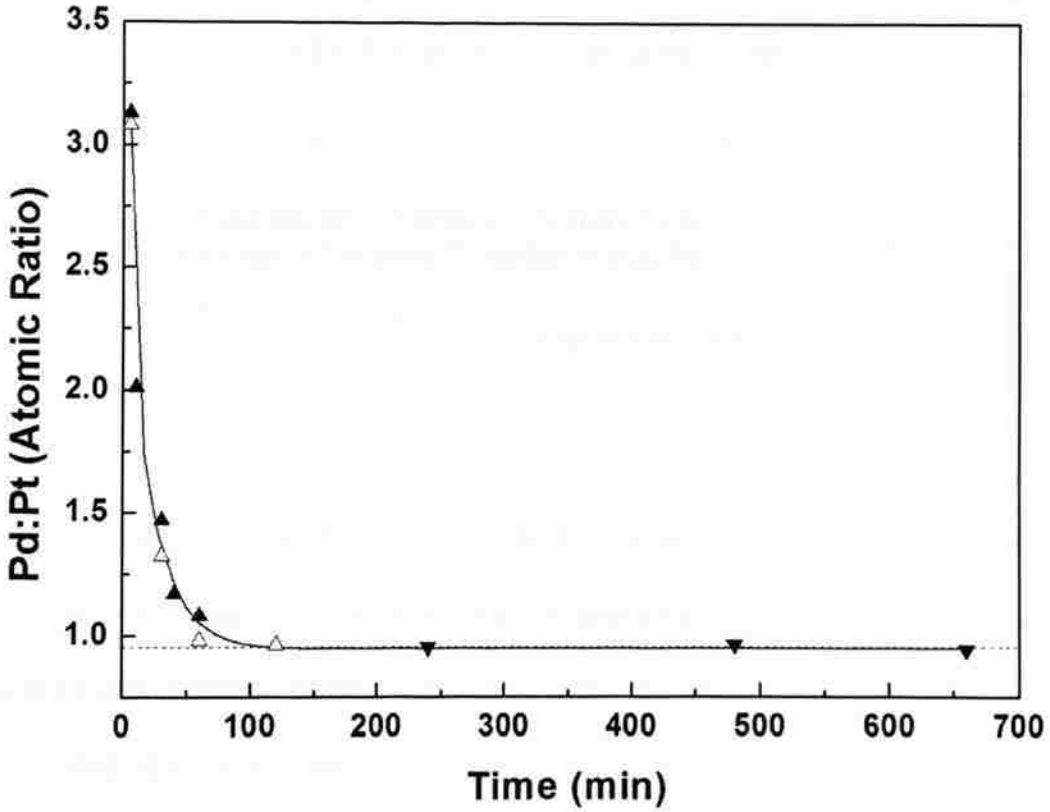


Figure 5. Alloy composition evolution of the Pd-Pt nanoparticles. The Pd to Pt atomic ratio reaches the preset ratio only after 120 min. Solid and open symbols represent results from three experiments. The solid line is a second order exponential fit line. The dotted line indicates the preset ratio of the alloy at Pd:Pt = 0.95.

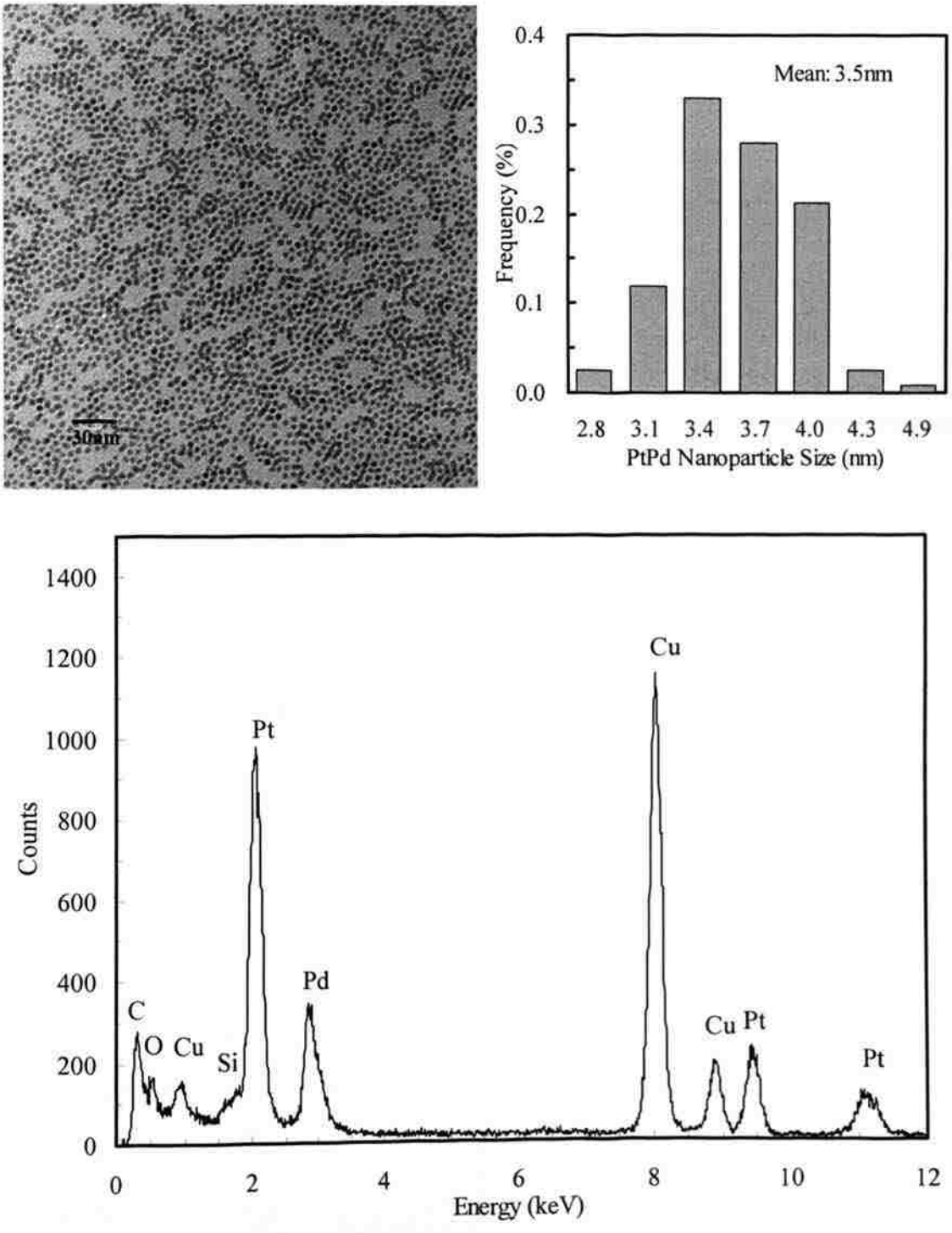


Figure 1. (a) TEM image of PtPd nanoparticles, (b) size distribution histogram, and (c) EDS spectrum of PtPd nanoparticles.

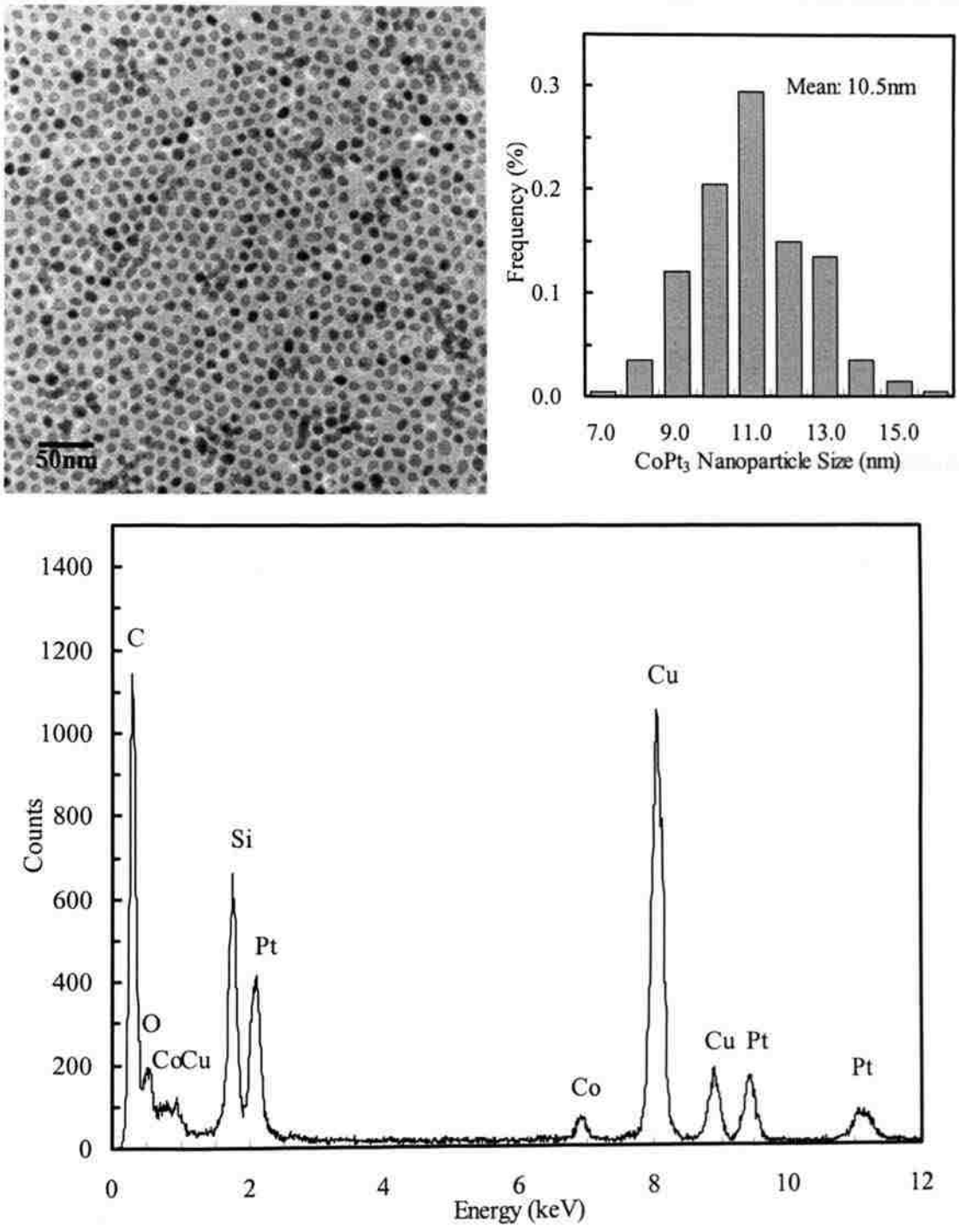
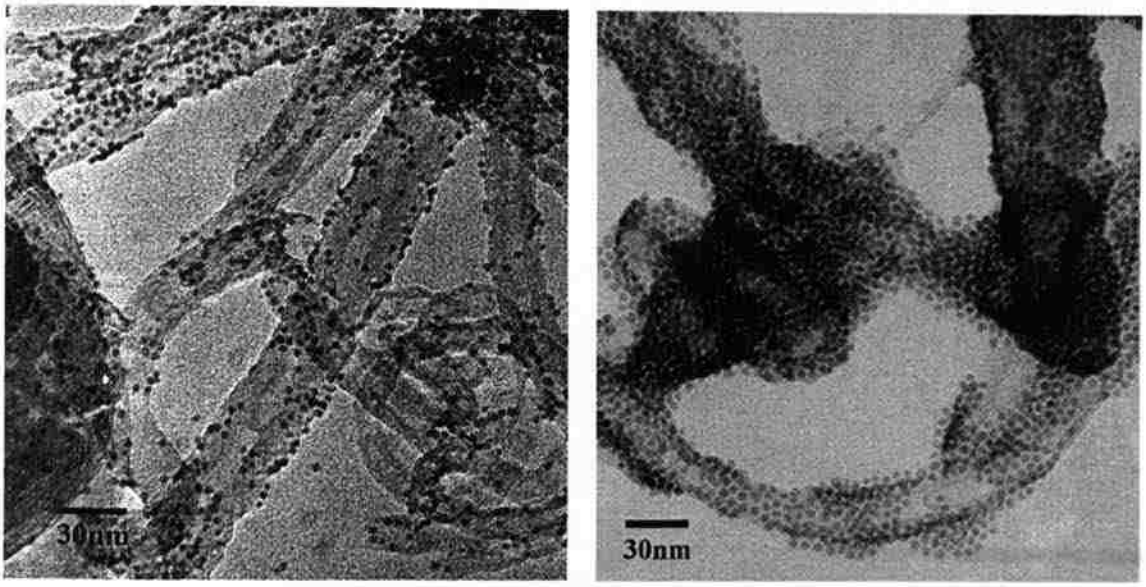


Figure 2. (a) TEM image of $CoPt_3$ nanoparticles, (b) size distribution histogram, and (c) EDS spectrum of PtPd nanoparticles.



(a) (b)

Figure 3. TEM images of the PtPd nanoparticles deposited on CNTs at two nanoparticle concentrations.

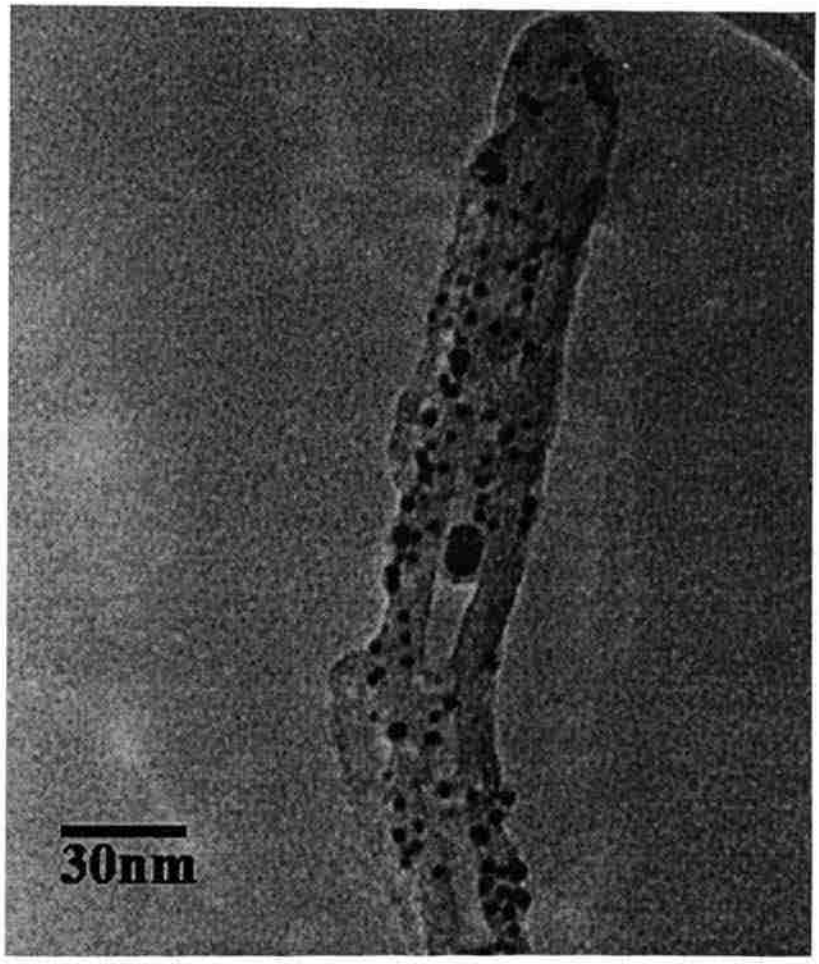


Figure 4. TEM image of sintered PtPd nanoparticles on CNTs heat treated at 300 °C.

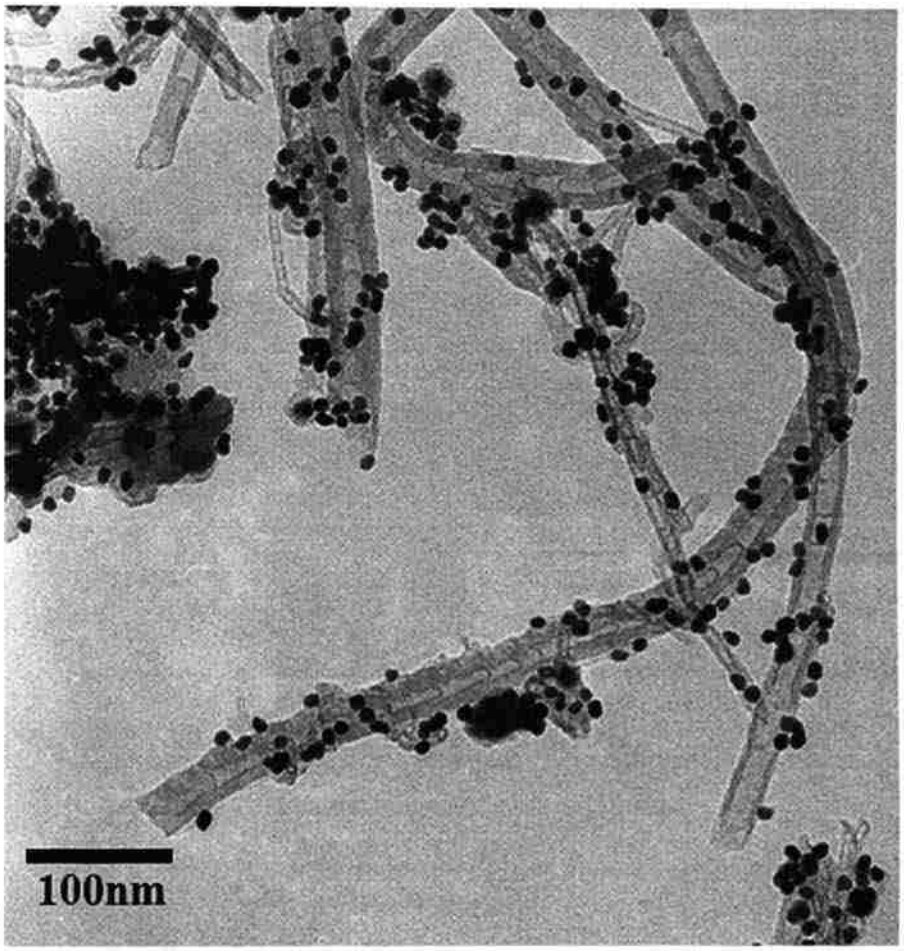


Figure 5. TEM image of the $CoPt_3$ nanoparticles deposited on CNTs.

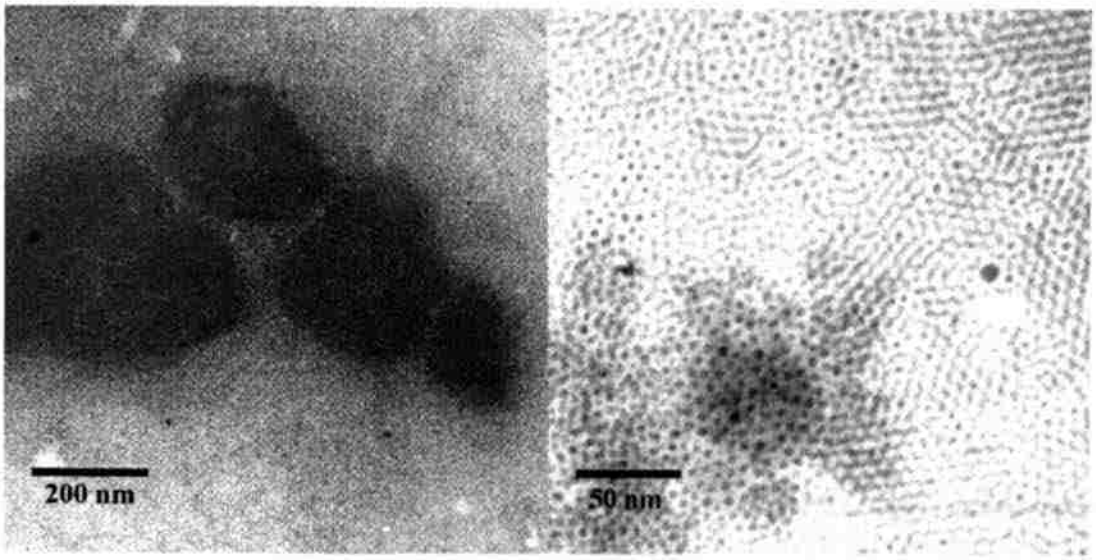
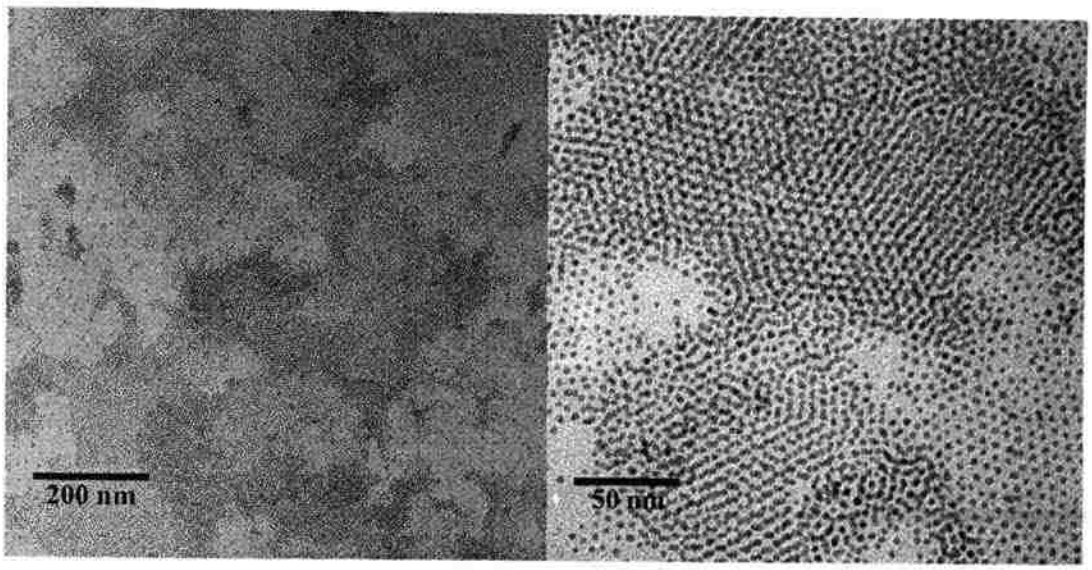
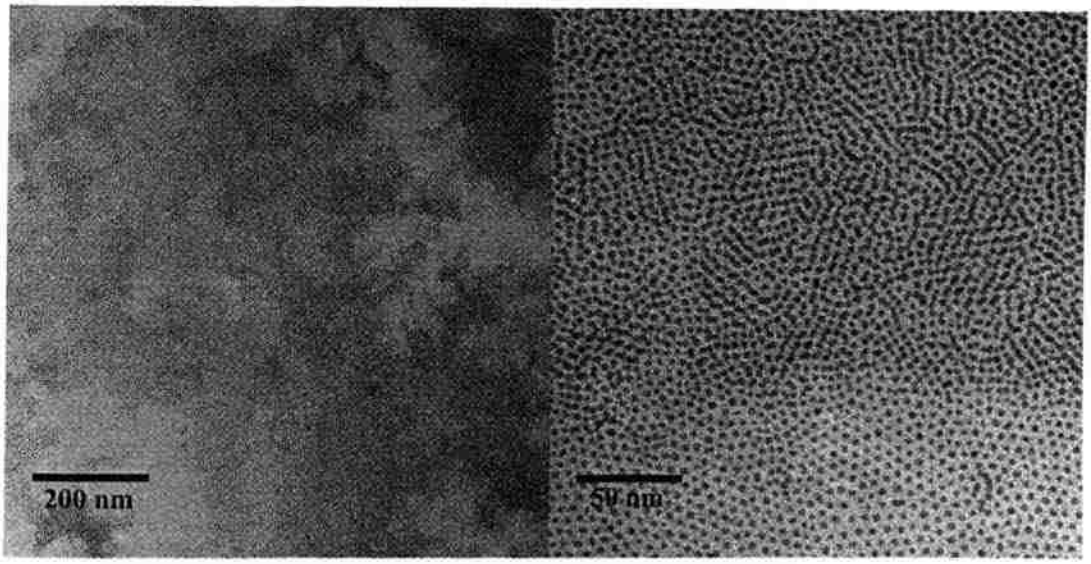


Figure A1. TEM images of PtPd superlattices formed at 23 °C.

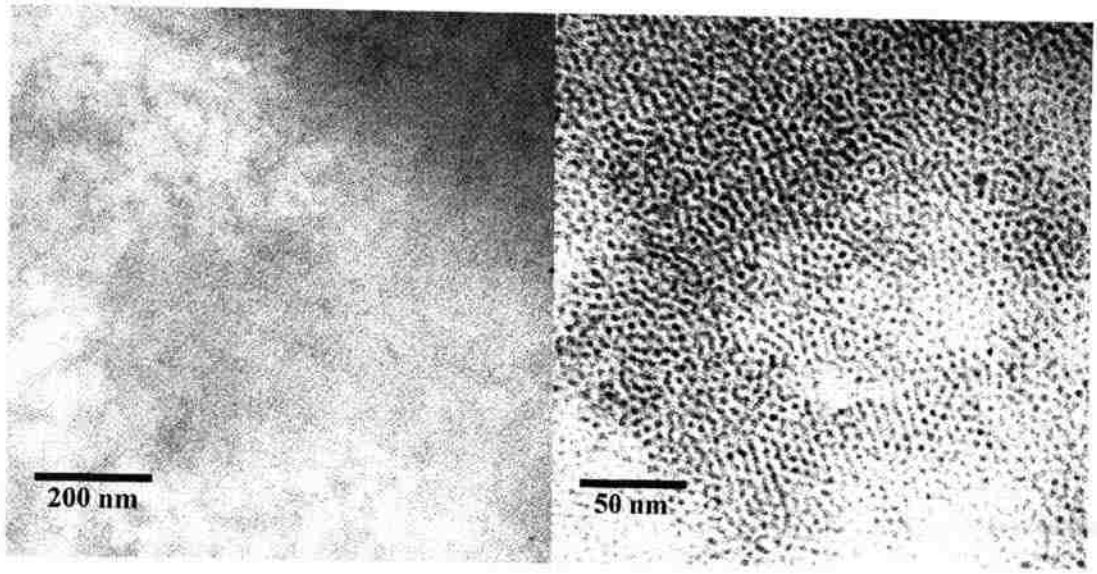


a-1 a-2

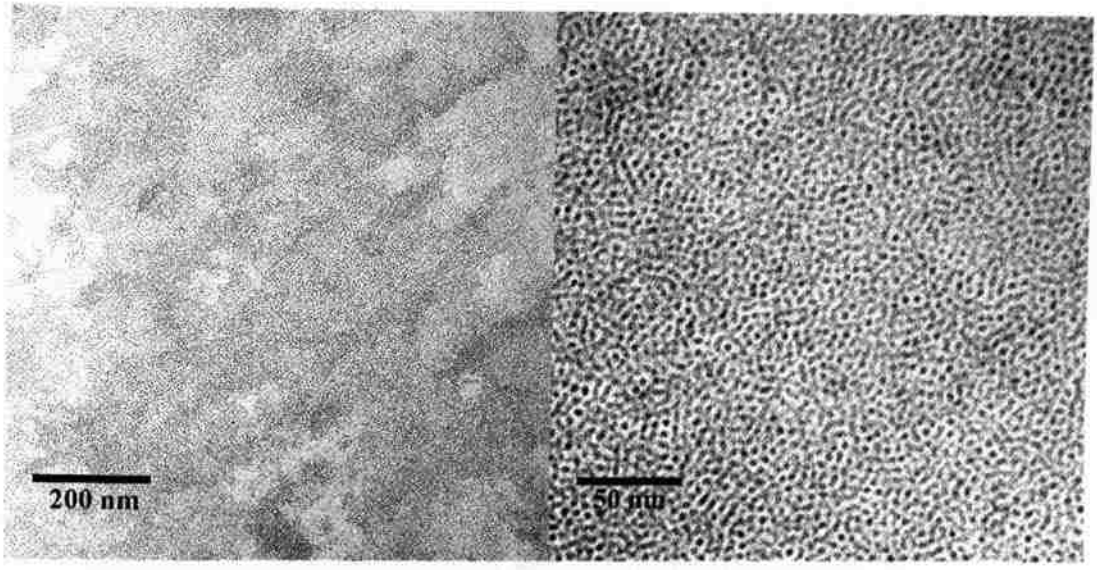


b-1 b-2

Figure A2. TEM images of PtPd superlattices upon heat treatment. PtPd superlattices were treated under different temperatures with the same duration of time; the temperatures from a-h are 60 – 130 °C with an increment of 10 °C.

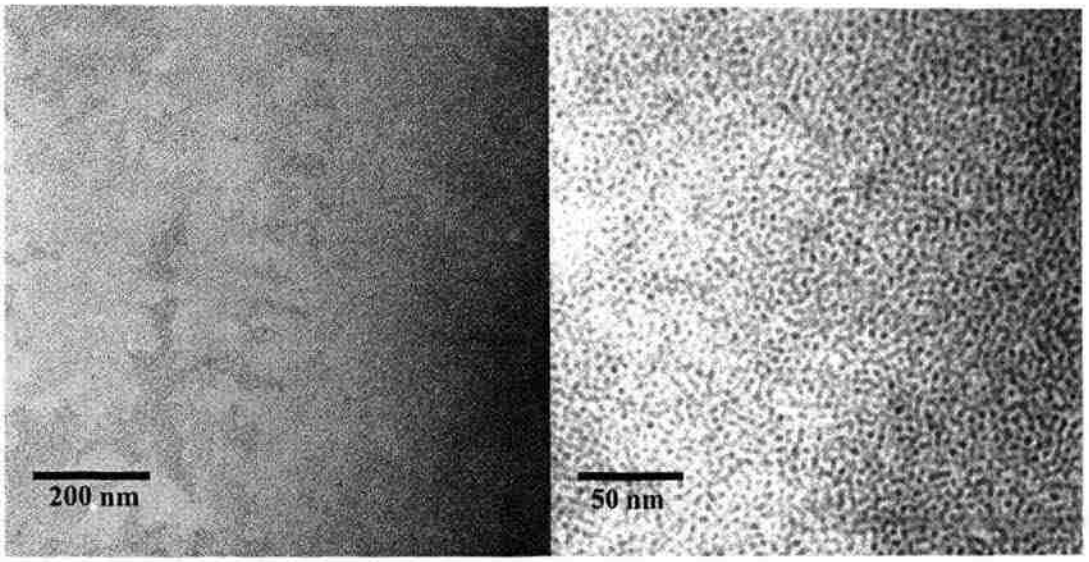


c-1 c-2

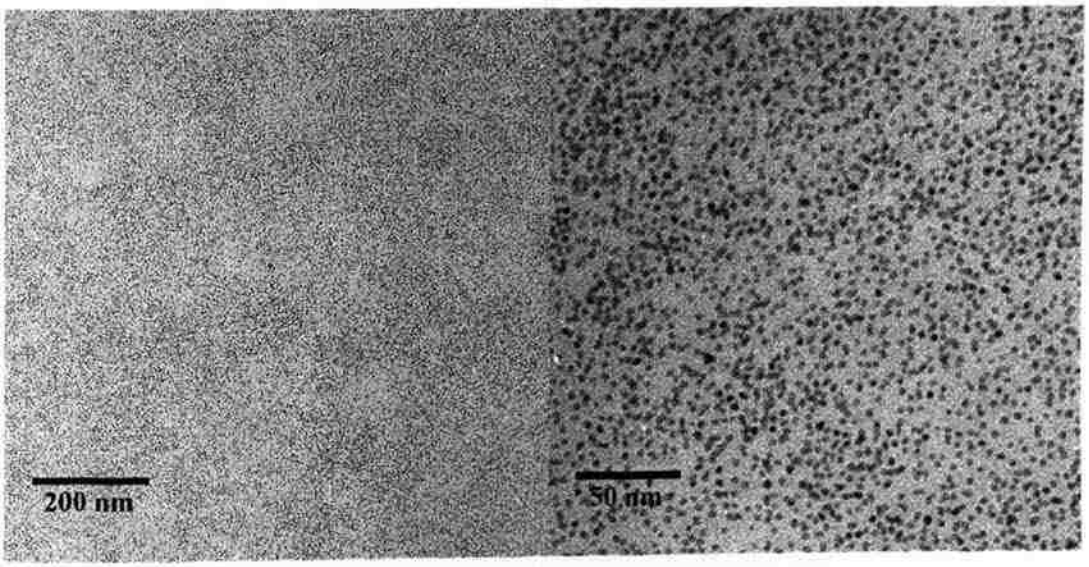


d-1 d-2

Figure A2. TEM images of PtPd superlattices upon heat treatment. PtPd superlattices were treated under different temperatures with the same duration of time; the temperatures from a-h are 60 – 130 °C with an increment of 10 °C. (cont.)

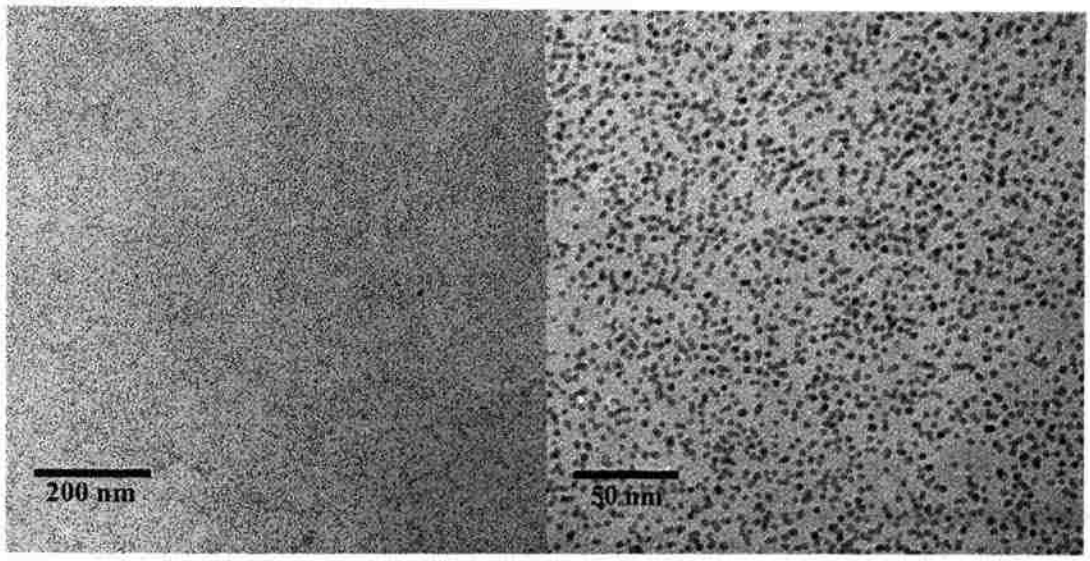


e-1 e-2

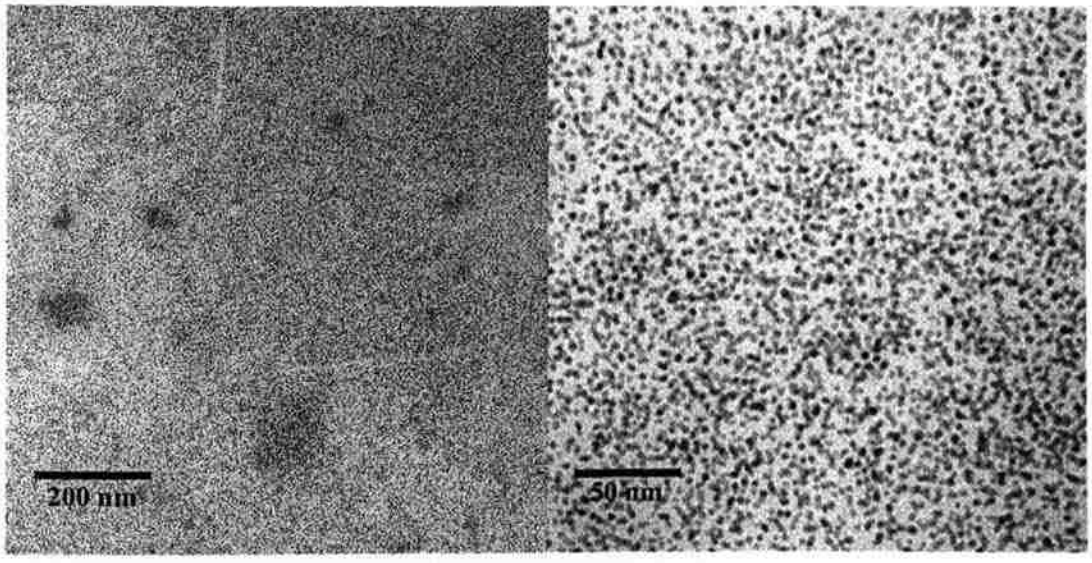


f-1 f-2

Figure A2. TEM images of PtPd superlattices upon heat treatment. PtPd superlattices were treated under different temperatures with the same duration of time; the temperatures from a-h are 60 – 130 °C with an increment of 10 °C. (cont.)



g-1 g-2



h-1 h-2

Figure A2. TEM images of PtPd superlattices upon heat treatment. PtPd superlattices were treated under different temperatures with the same duration of time; the temperatures from a-h are 60 – 130 °C with an increment of 10 °C. (cont.)

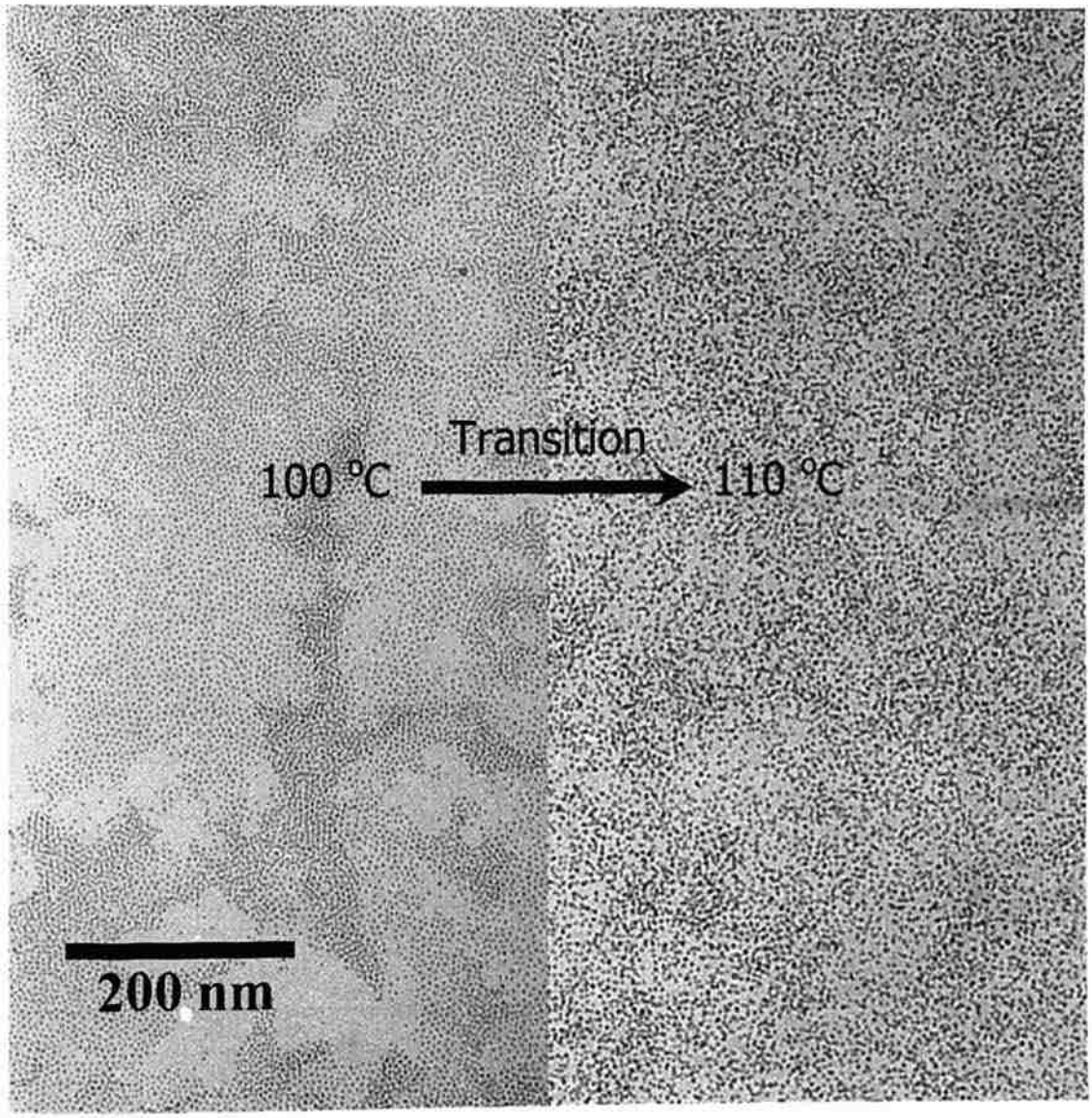
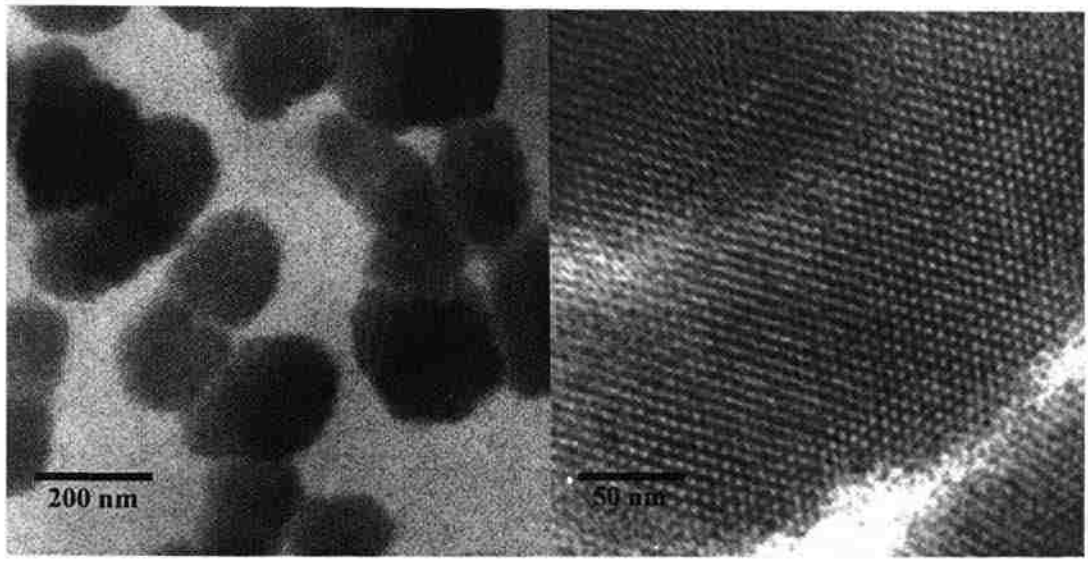
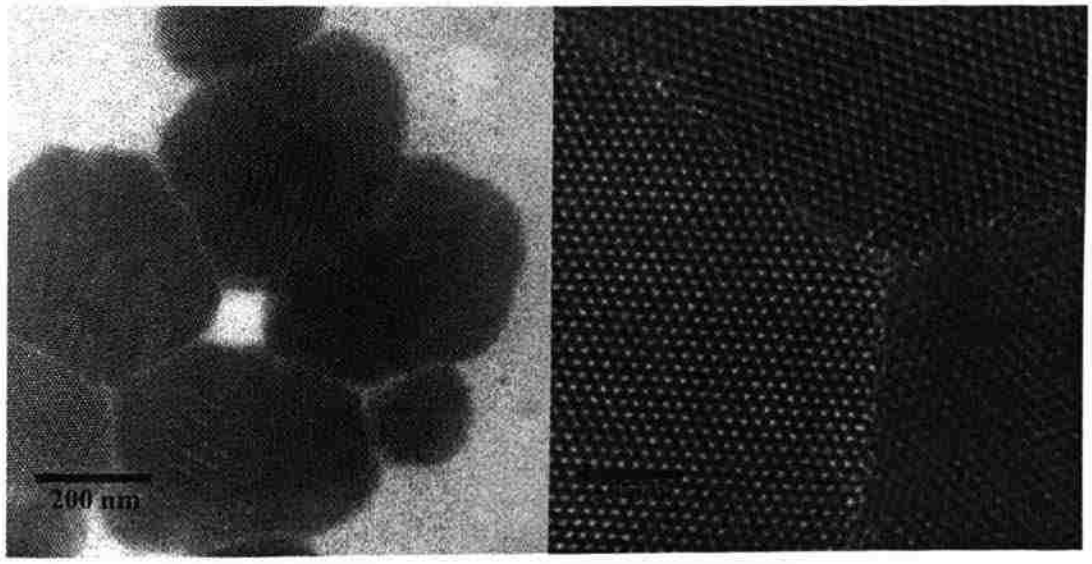


Figure A3. Transition of PtPd superlattices from an ordered structure to a disordered state upon critical temperature.

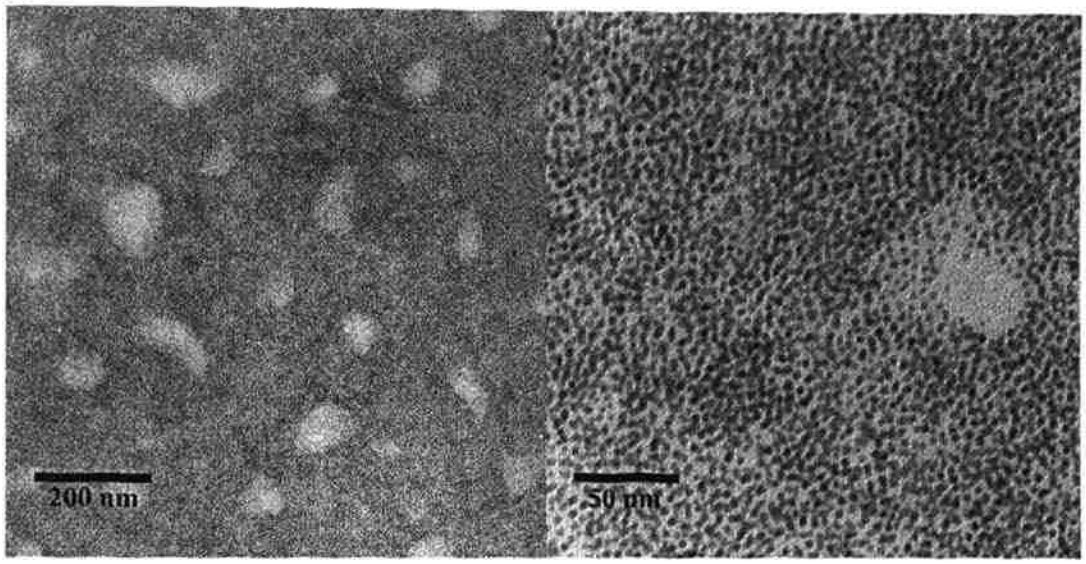


a-1 a-2

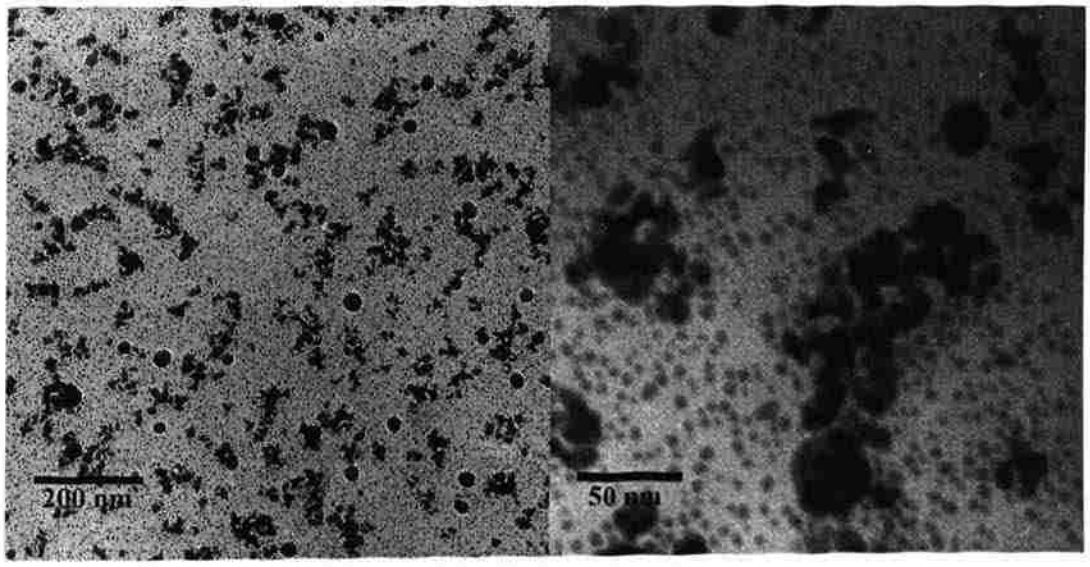


b-1 b-2

Figure A4. Temperature-induced restructuring of PtPd superlattices. Sample a is the sample prepared under room temperature 23 °C. b-d are heat treated samples with temperatures 50, 150 and 250 °C, respectively.



c-1 c-2



d-1 d-2

Figure A4. Temperature-induced restructuring of PtPd superlattices. Sample a is the sample prepared under room temperature 23 °C. b-d are heat treated samples with temperatures 50, 150 and 250 °C, respectively. (cont.)

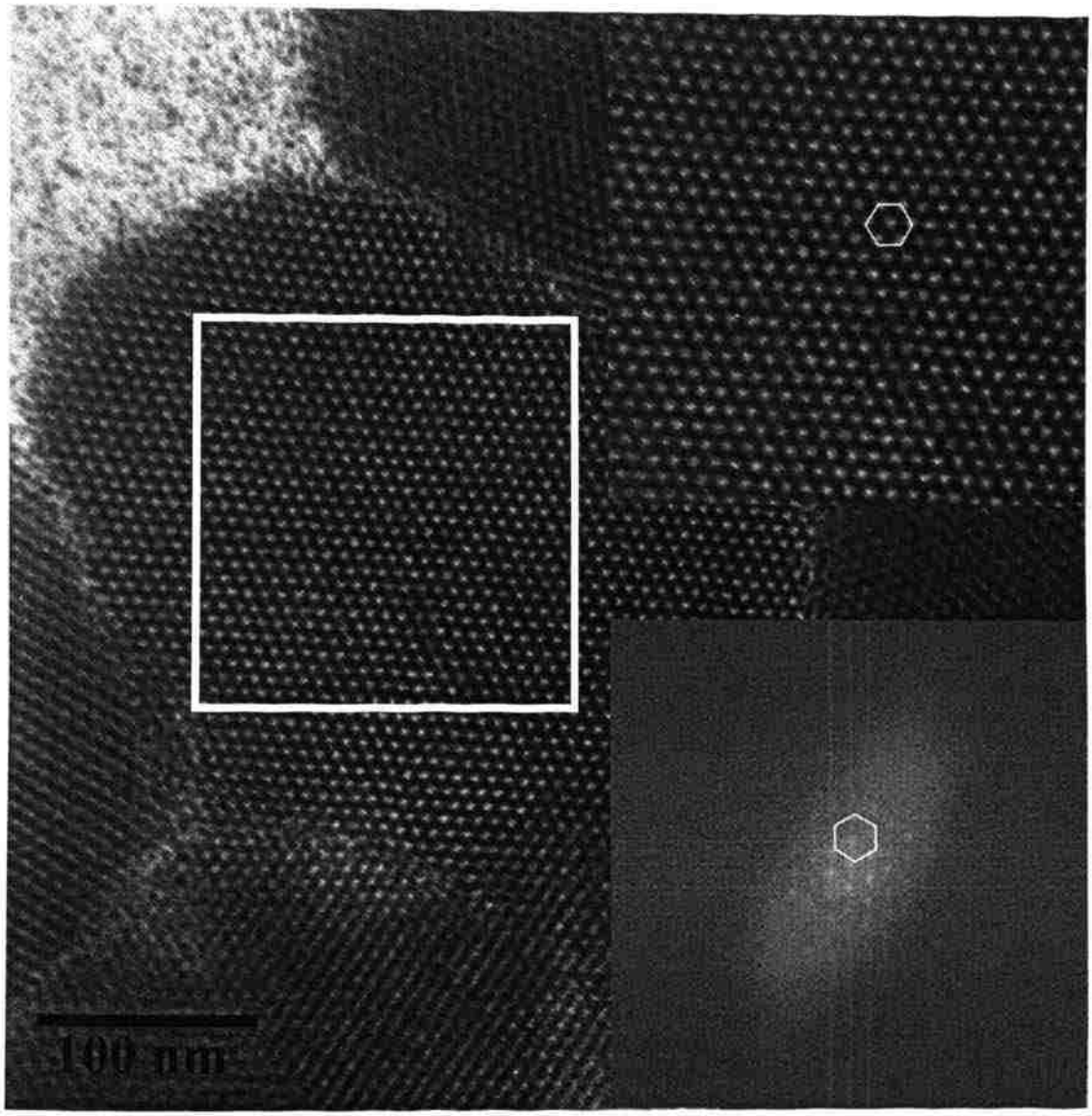


Figure A5. TEM images of 50 °C heat treated PtPd superlattices and the FFT image.