

# Atomic scale imaging the growth and transformation of $\text{Pt}_3\text{Ni-NiO}$ nanoparticles

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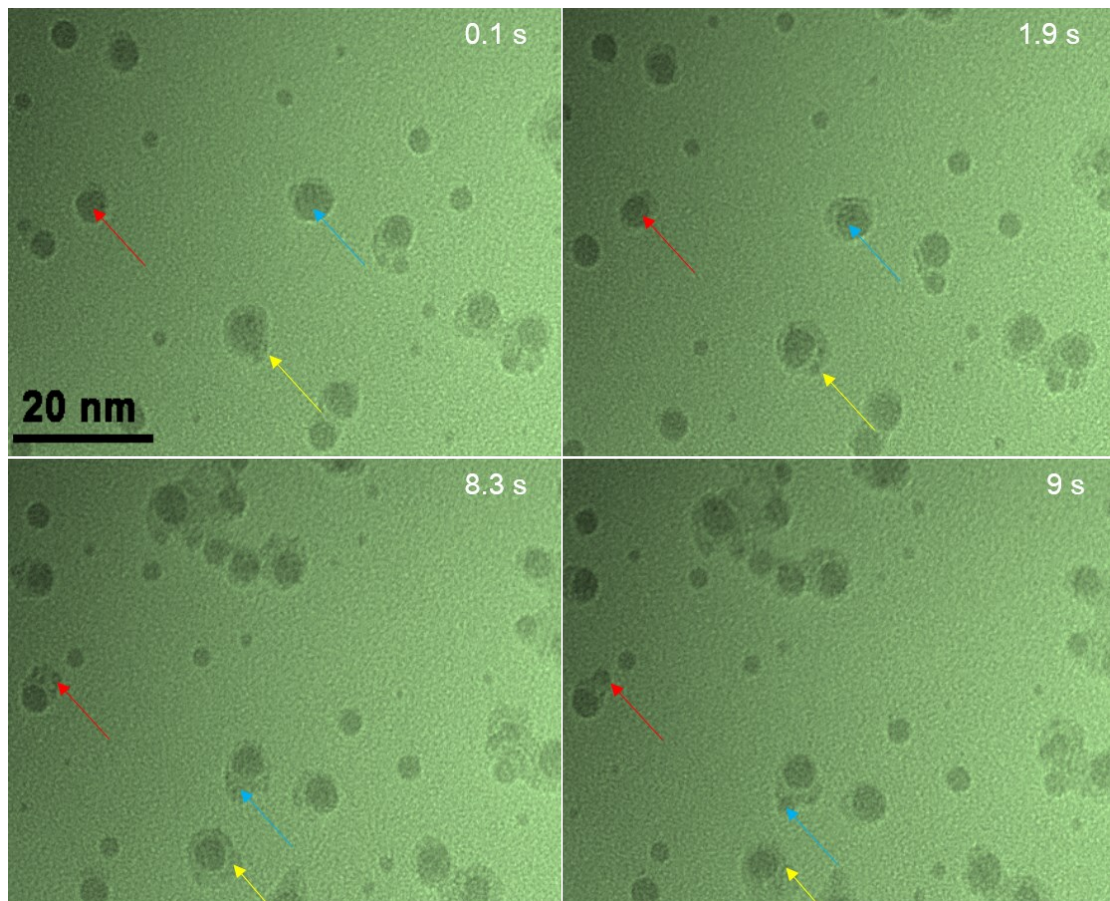
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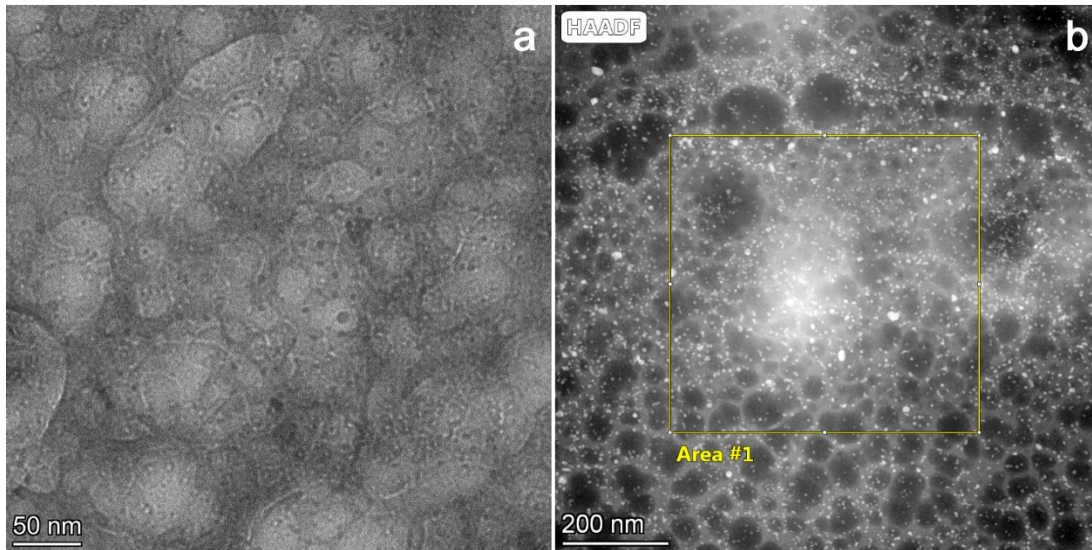
E-mail: [zjy2020@hqu.edu.cn](mailto:zjy2020@hqu.edu.cn)



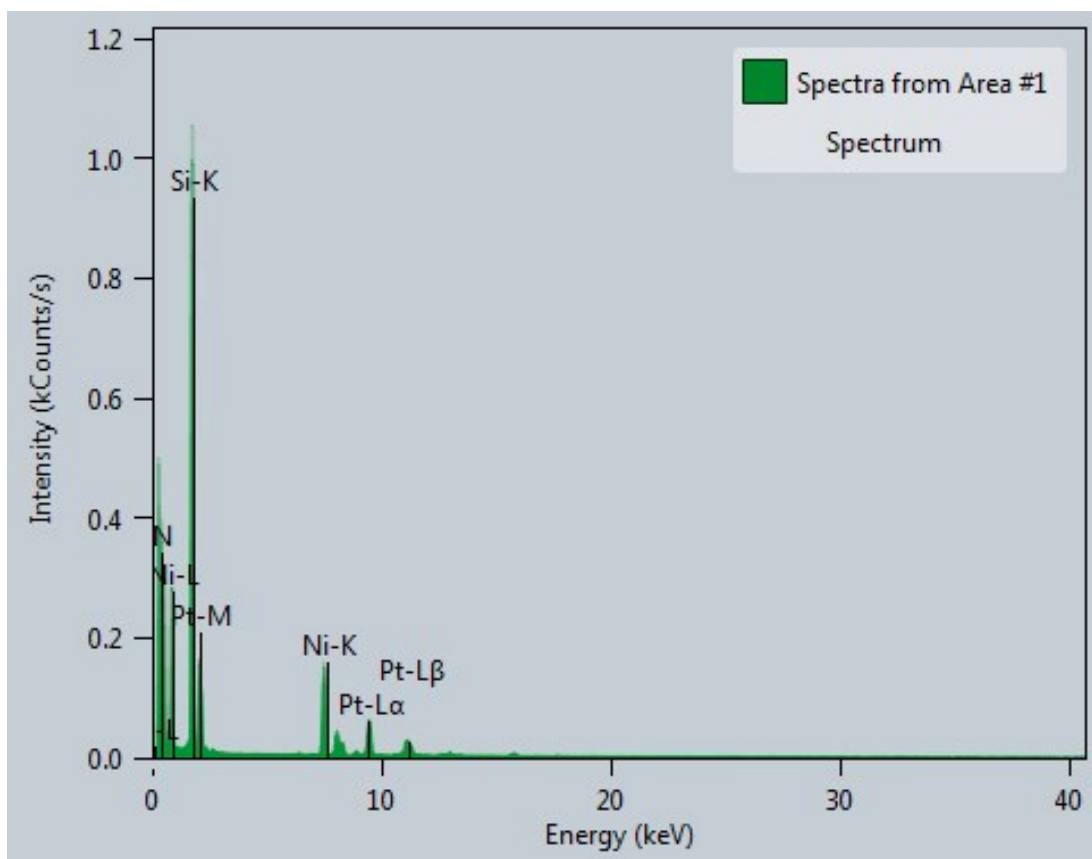
**Figure S1** The photograph of SiNx liquid cells.



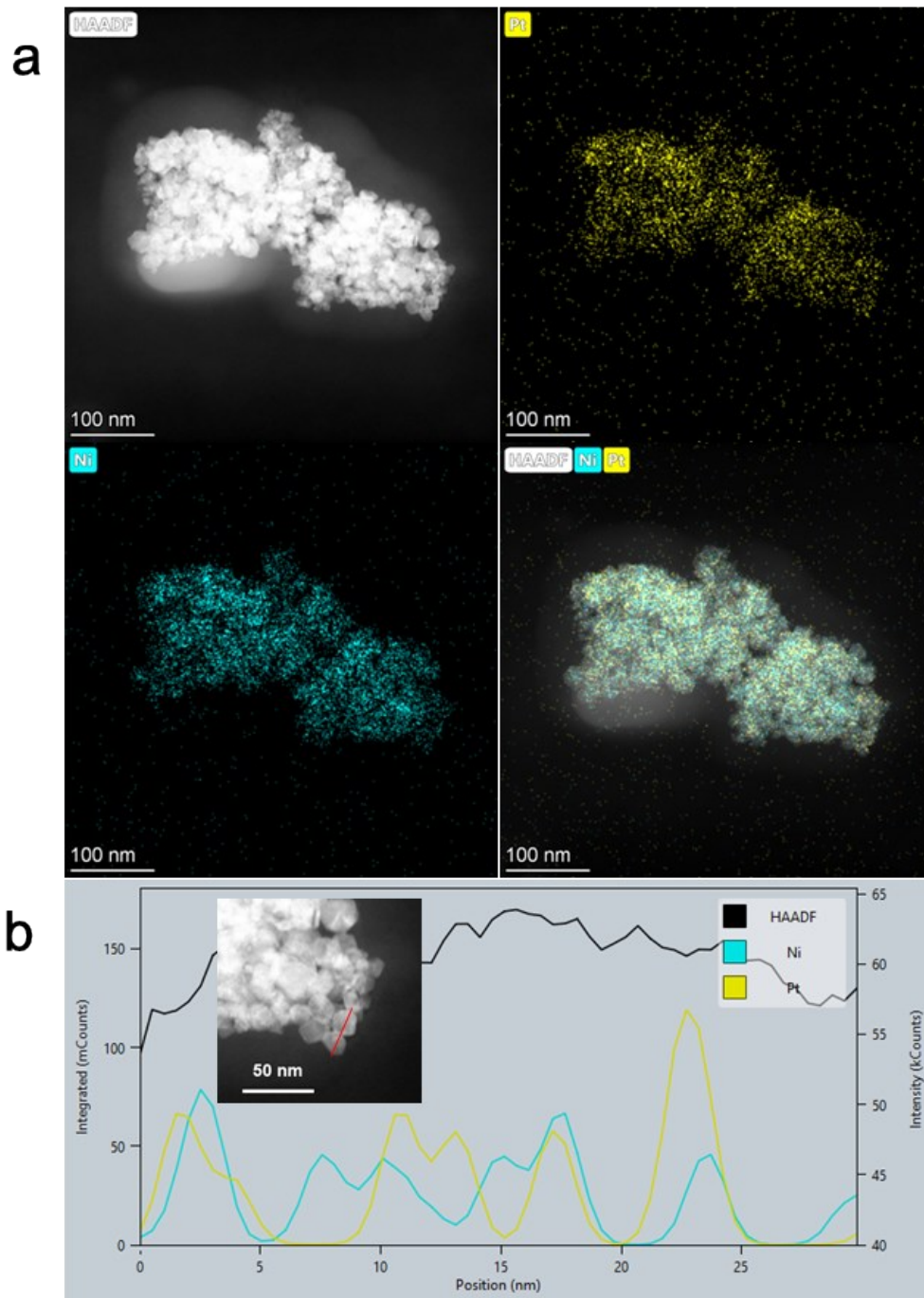
**Figure S2** The low-resolution TEM images showing the growth trajectory of the Pt-Ni-oxide core-shell nanoparticles in the precursor solution with Pt:Ni=1:1.25.



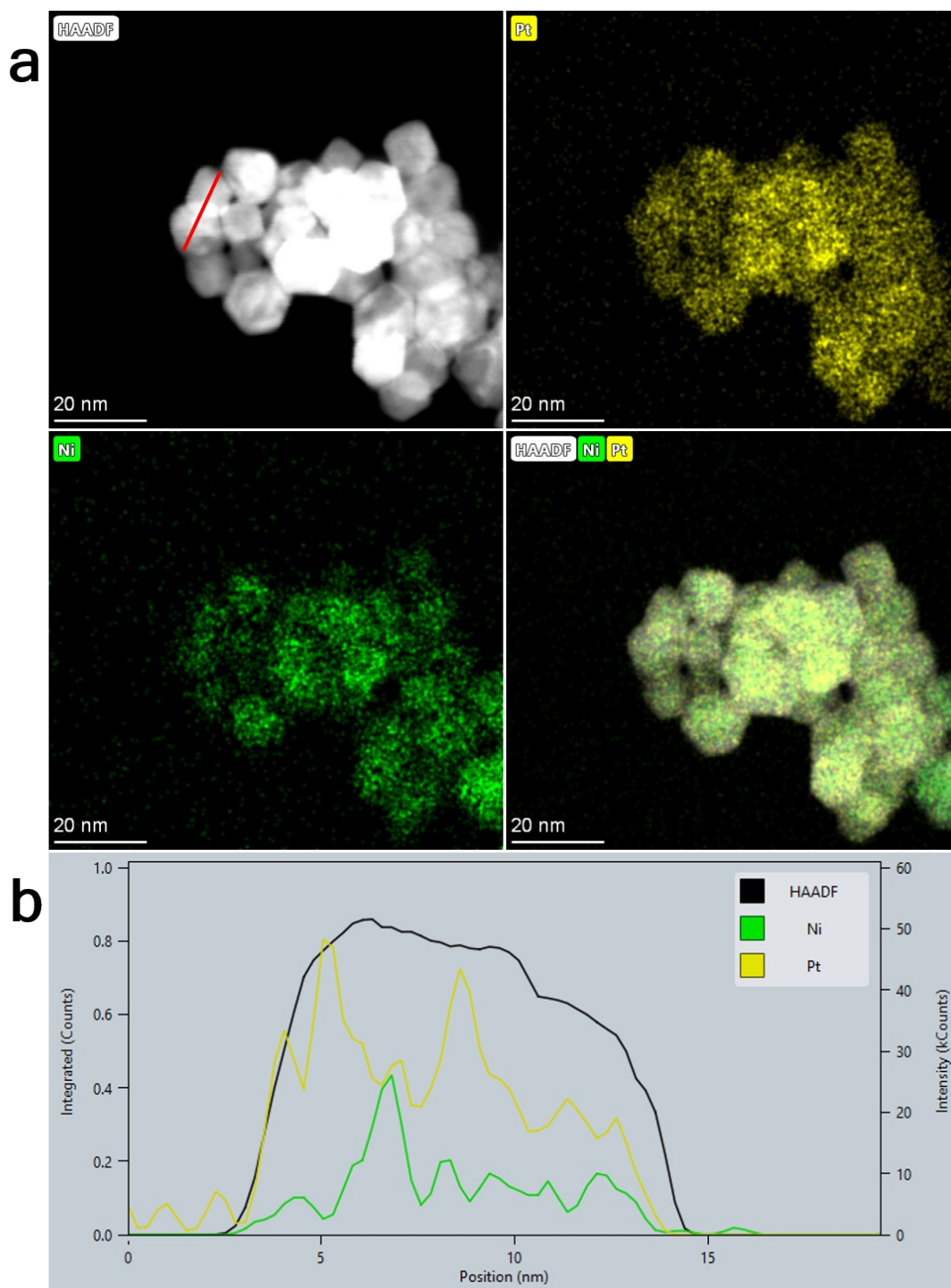
**Figure S3** The TEM and HAADF STEM images of all the nanoparticles in liquid cell.



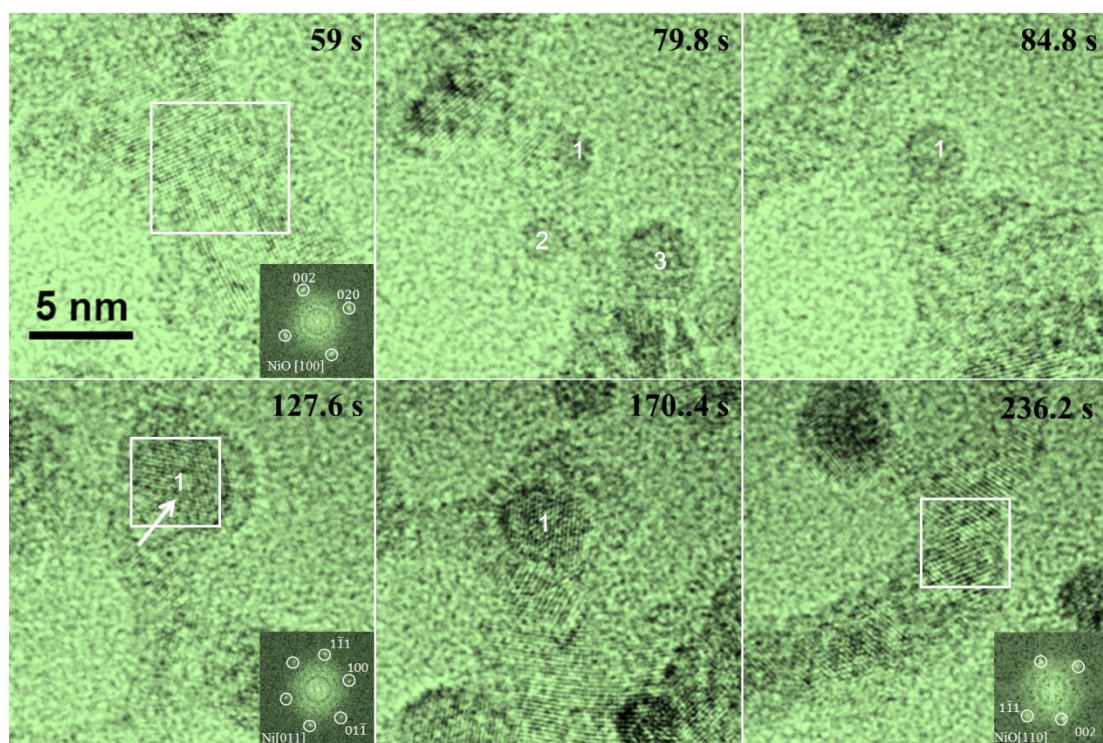
**Figure S4** The EDS spectra of nanoparticles in Figure S2 b.



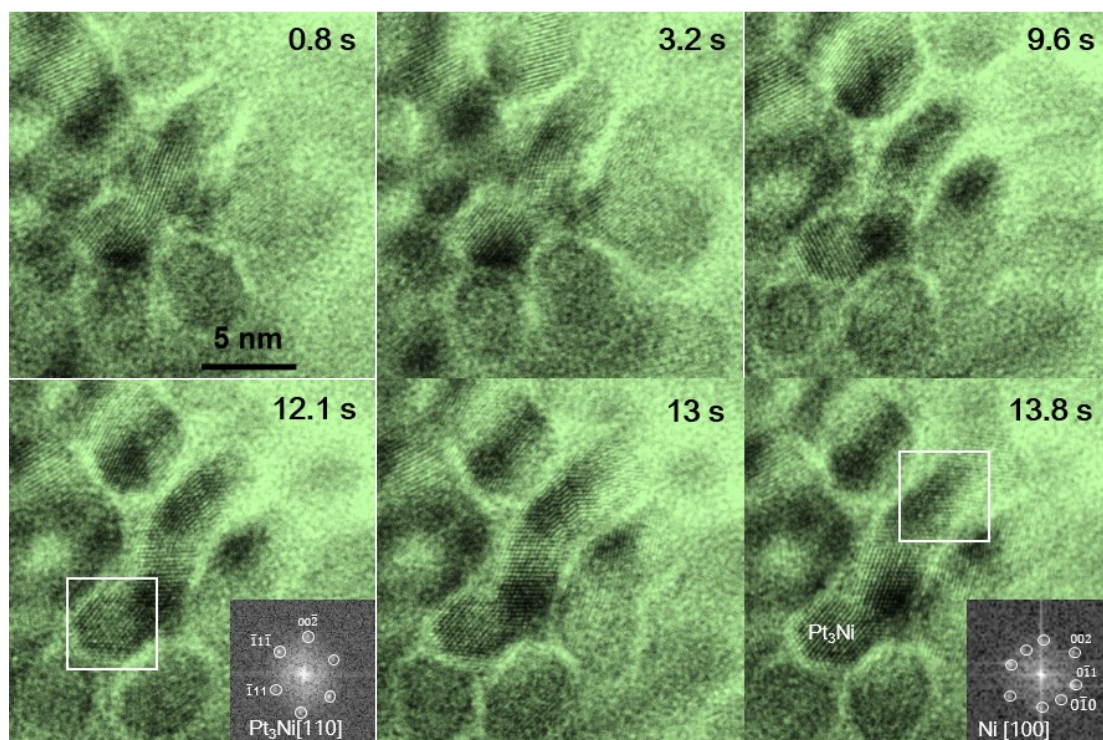
**Figure S5** (a) The HADDF STEM image and EDS mapping of local nanoparticles in  $\text{SiN}_x$  liquid cell. (b) The corresponding line scanning image of two nanoparticles (inset HADDF STEM)



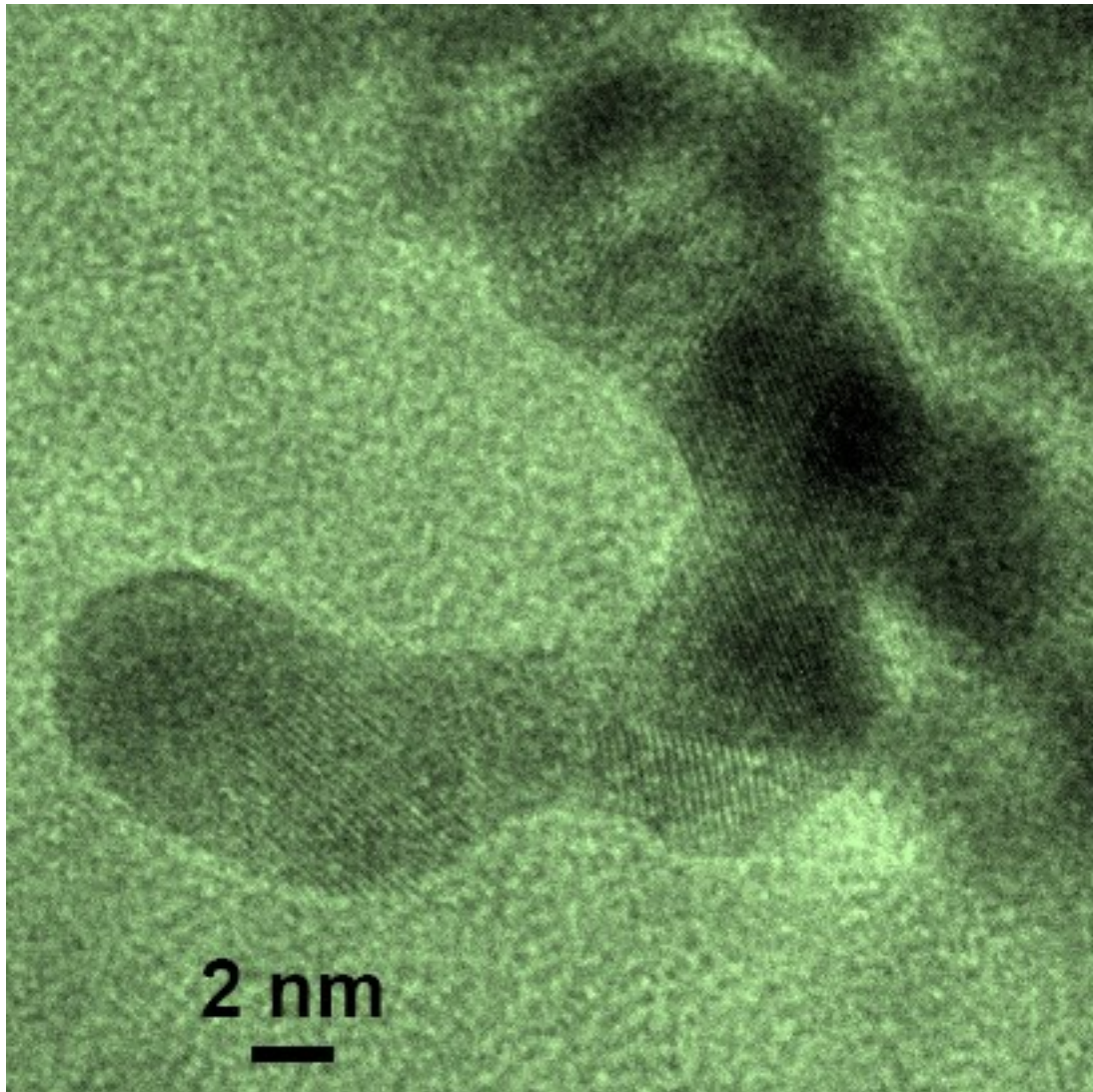
**Figure S6** (a) The HADDF STEM image and EDS mapping of local nanoparticles by ex-TEM (b) The corresponding line scanning image of two nanoparticles in STEM image of Figure S6 a.



**Figure S7** Sequential TEM images extracted from Movie S3 showing the dynamic facet transformation of NiO nanocrystal from {100} facet (inset FFT) to {110} facet (inset FFT) via a Ni nanoparticle with {011} facet (inset FFT) as intermediate.



**Figure S8** Sequential HR TEM images showing the growth of a long Pt<sub>3</sub>Ni-Ni in the precursor solution with Pt:Ni=1:1.25 at 6873 e<sup>-</sup>/Å<sup>2</sup>·s extracted from Movie S4.



**Figure S9** The HR TEM images of Pt<sub>3</sub>Ni nanowires

### 1. Movie Captions

**Movie S1:** the growth trajectory of the Pt-Ni-oxide core-shell nanoparticles in the precursor solution with Pt:Ni=1:1.25. The movie plays twelve times faster than real time. The dose rate during the data collection is about 3320 e/Å<sup>2</sup>·s.

**Movie S2:** the dynamic structural evolution during the growth of Pt-Ni-oxide core-shell nanoparticles in the precursor solution with Pt:Ni=1:1.25 at a high dose rate. The movie plays twelve times faster than real time. The dose rate during the data collection is about 4900 e/Å<sup>2</sup>·s.

**Movie S3:** the dynamic facet transformation of NiO nanocrystal from {100} facet to {110} facet via Ni nanoparticle with {100} facet as intermediate in the precursor solution with Pt:Ni=1:1.25. The movie plays six times faster than real time. The dose



rate during the data collection is about  $4900 \text{ e}/\text{\AA}^2\cdot\text{s}$ .

**Movie S4:** the formation of new interface structure of Pt<sub>3</sub>Ni-Ni nanoparticles in the precursor solution with Pt:Ni=1:1.25. The movie plays three times faster than real time. The dose rate during the data collection is about  $6873 \text{ e}/\text{\AA}^2\cdot\text{s}$ .

**Movie S5:** the growth trajectory of Pt<sub>3</sub>Ni nanowires in the precursor solution with Pt:Ni=2.5:1 at low dose rate. The movie plays twelve times faster than real time. The dose rate during the data collection is about  $2520 \text{ e}/\text{\AA}^2\cdot\text{s}$ .

**Movie S6:** the growth trajectory of Pt<sub>3</sub>Ni nanowires in the precursor solution with Pt:Ni=2.5:1 at low dose rate. The movie plays twelve times faster than real time. The dose rate during the data collection is about  $5000 \text{ e}/\text{\AA}^2\cdot\text{s}$ .