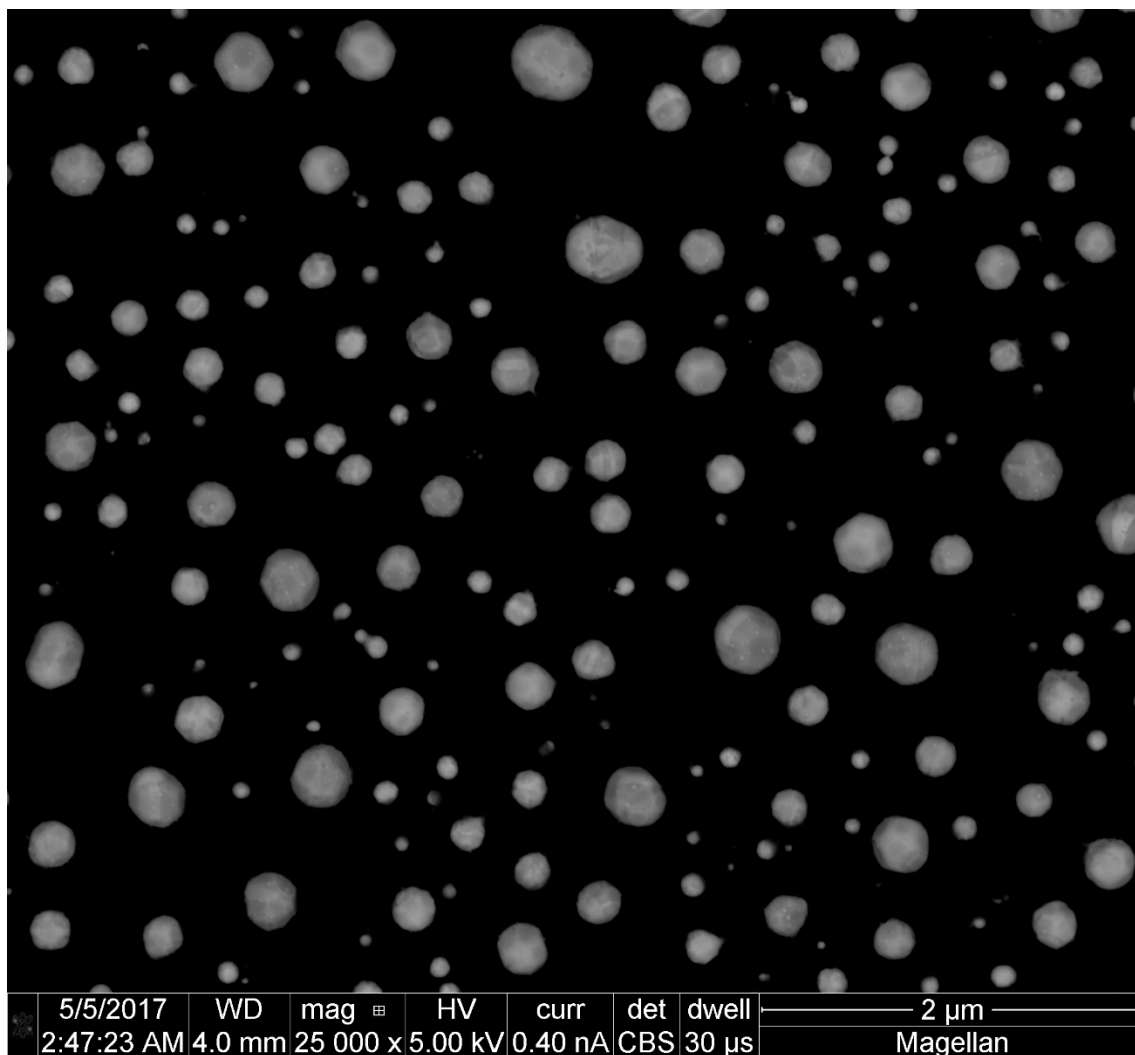
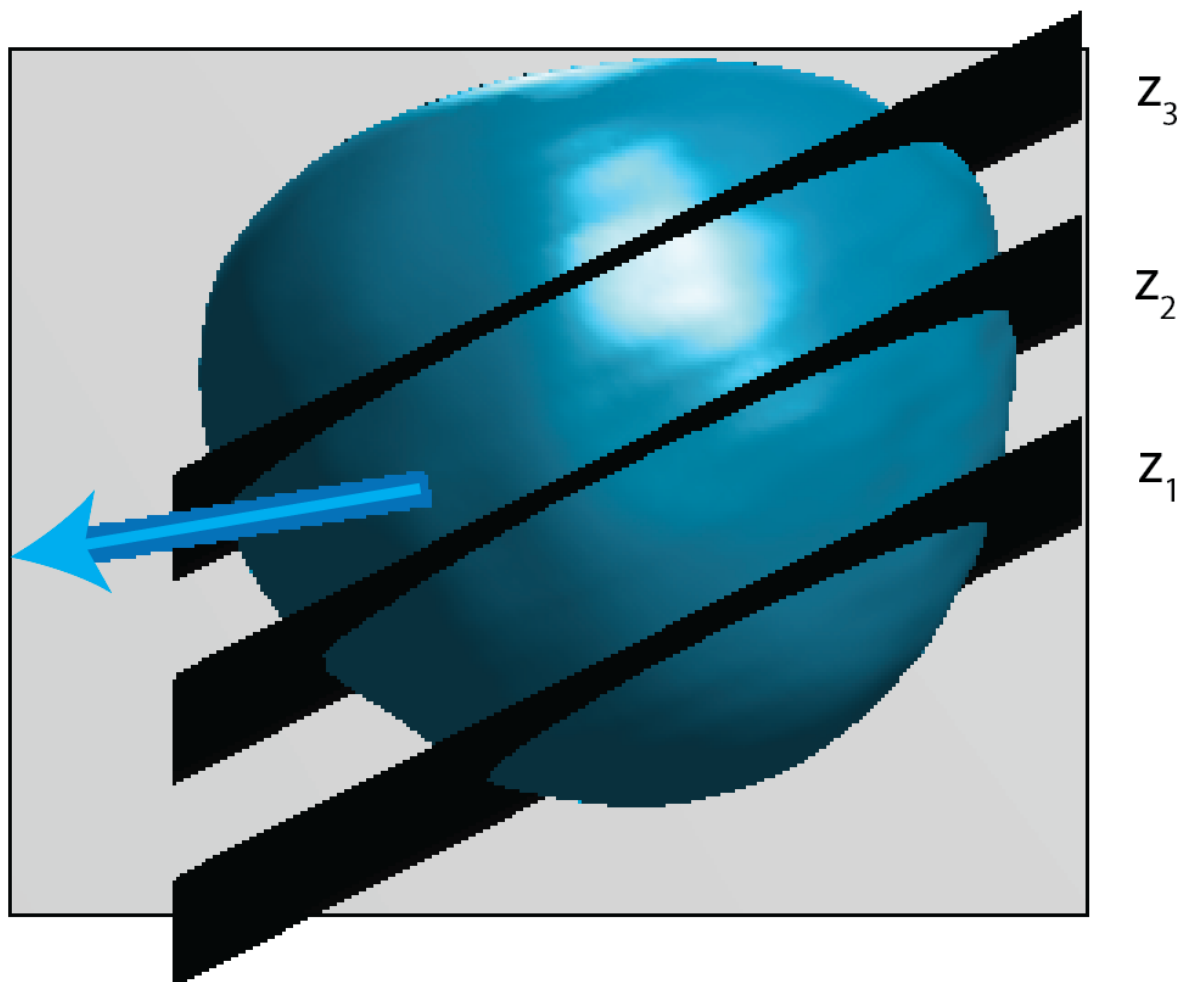


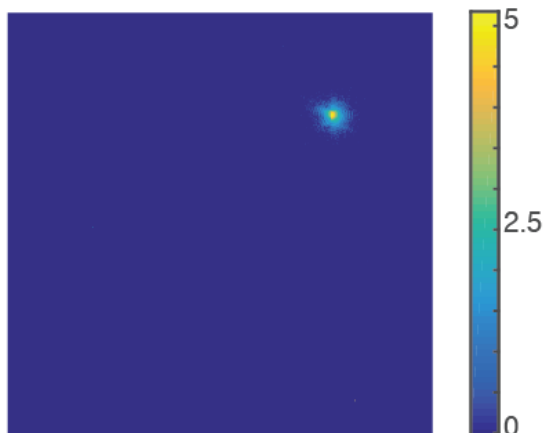


Supplementary Figure 1. Electron microscopy image of the as-synthesized Pd nanoparticles. The particles tend to be roughly spherical in shape.



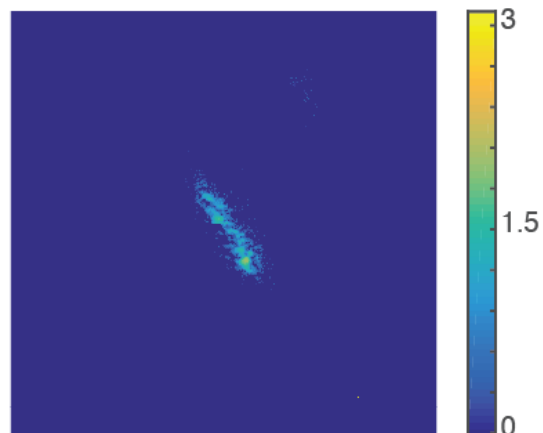
Supplementary Figure 2. Cross-section locations for the cross-sections shown in Figure 1. The measured scattering vector is shown as a blue arrow.

a Initial State



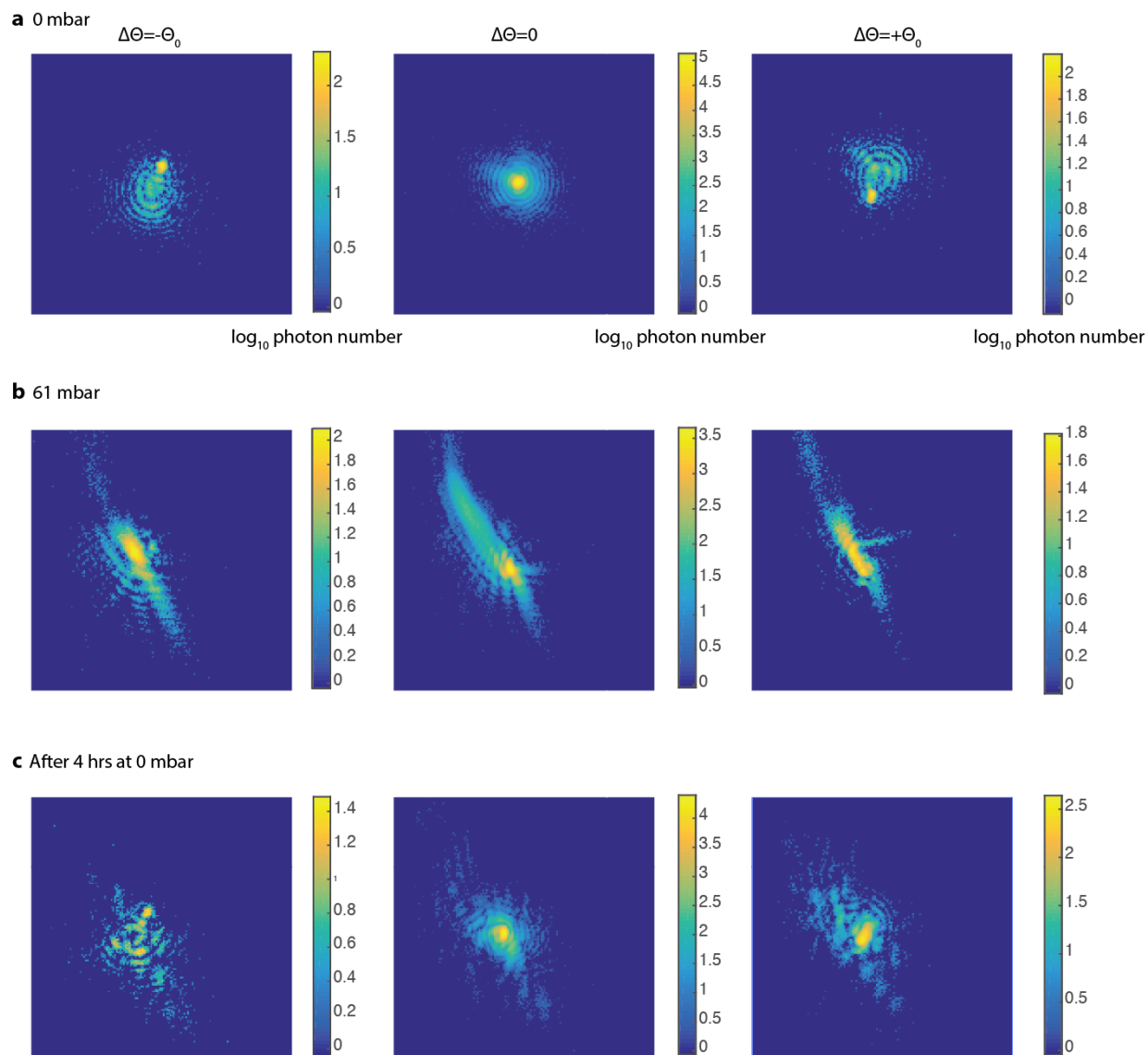
$\log_{10}$ photon number

b Complete Transformation



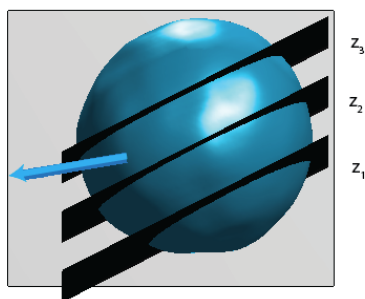
$\log_{10}$ photon number

Supplementary Figure 3. Coherent diffraction data for Pd particle discussed in the main text. (a) The as-synthesized state. (b) After the complete transformation. In **b** there is a lack of centrosymmetry, a clearly defined central maximum, and the spread in the diffraction pattern is much larger than in **a**. All of these features are consistent with a highly defective particle.

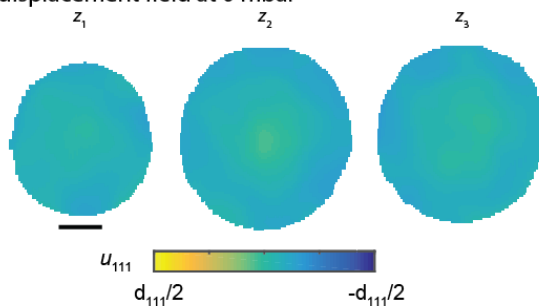


Supplementary Figure 4. Coherent diffraction data used for the reconstructions shown in Figure 1. Three cross-sections are shown. The nucleation and healing of the defects are evident in the diffraction data. **(a)** The Pd nanoparticle diffraction data in the as-synthesized state. **(b)** The Pd nanoparticle diffraction data at 61 mbar pH_2 . **(c)** The Pd nanoparticle diffraction data at 0 mbar pH_2 after 4 hours.

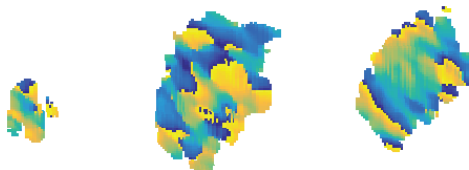
a Cross-section locations



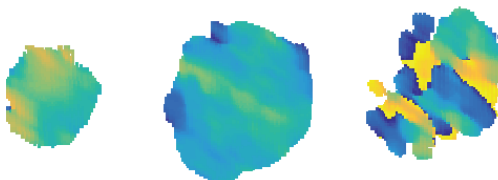
b u_{111} displacement field at 0 mbar



c u_{111} displacement field at 61 mbar

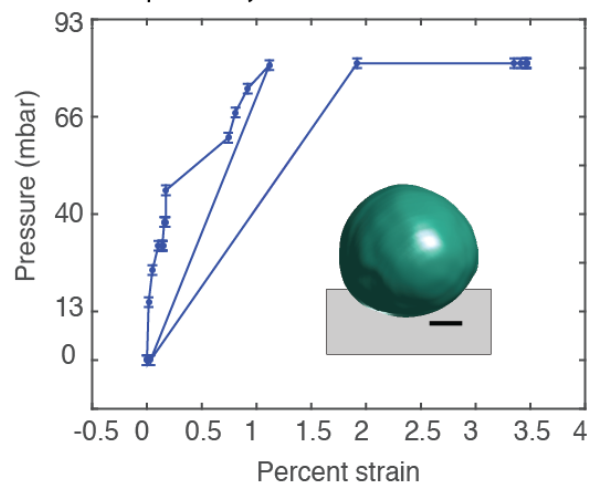


d u_{111} displacement field at after 4 hours at 0 mbar

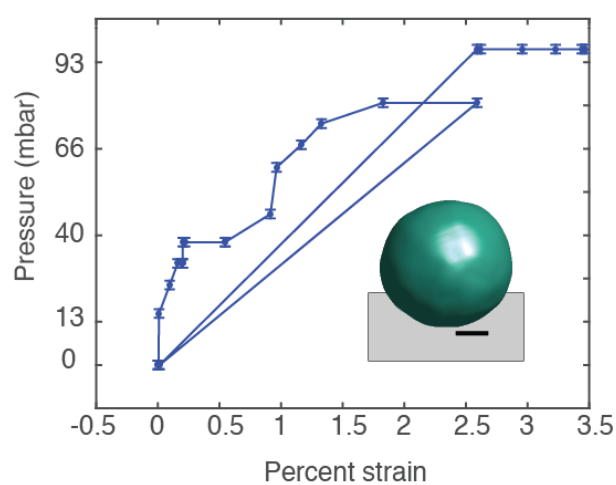


Supplementary Figure 5. Another Pd nanoparticle that shows defect nucleation and subsequent healing. The scale bar represents 100 nm. **(a)** The spatial locations of the cross-sections shown in **b-d**. **(b)** Three cross-sections showing the as-synthesized displacement field. The particle is nearly strain-free and is free of dislocations. **(c)** Cross-sections showing defects induced in the particle center due to the partial transformation at 61 mbar. **(d)** Cross-sections showing defects healing in the particle center due to 4 hours at 0 mbar. The defects have healed in cross-section z_2 and some remain in cross-section z_3 .

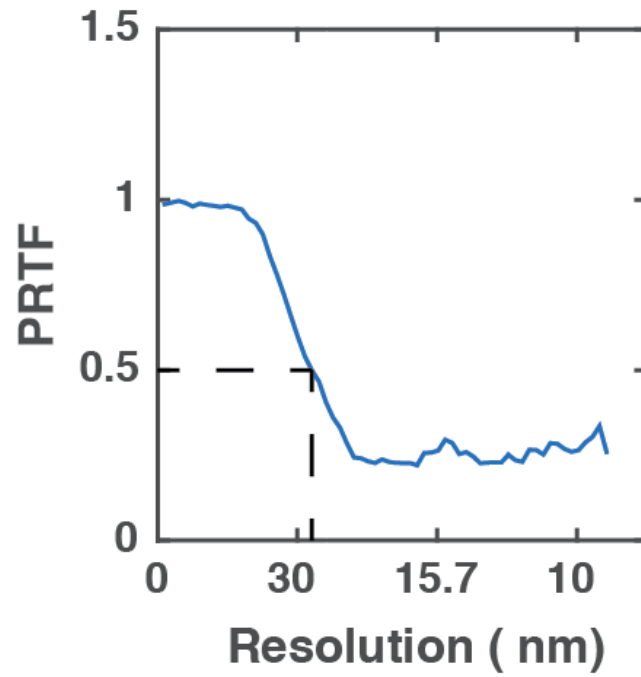
a Particle previously discussed



b Particle 2



Supplementary Figure 6. Pressure-strain isotherms for the particles discussed in the main text. The scale bar represents 100 nm. The return to 0 mbar is shown in this Figure. Error bars show the average drift in the pressure gauge over the course of the measurement.



Supplementary Figure 7. The phase retrieval transfer function. A conservative cutoff of 0.5 is used to estimate the resolution as between 20-30 nm.