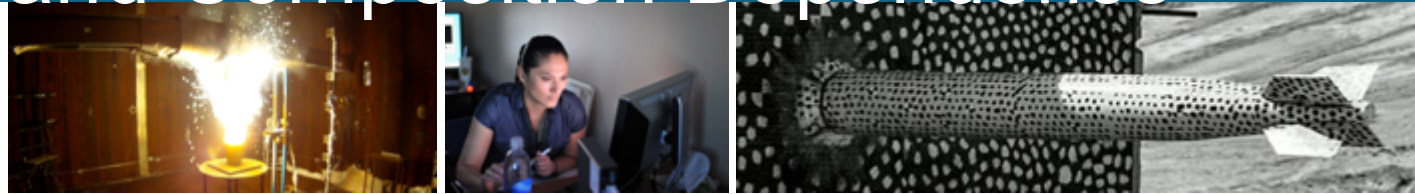




In-Situ Annealing of Pt-Au Alloys: Grain Growth with Temperature and Composition Dependence



Summer 2020

Emily M. Hopkins, Chris M. Barr, Trevor Clark, Riley Parrish, David P. Adams, Khalid Hattar



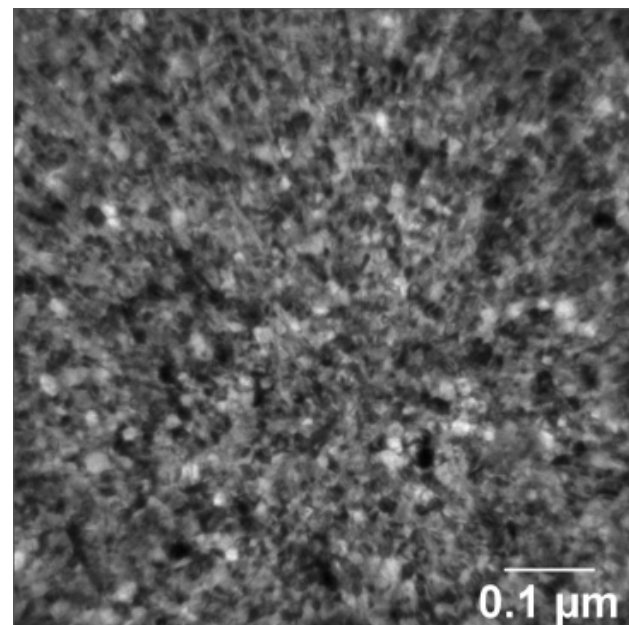
Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

- DC Magnetron sputtered Pt-Au alloys
 - Deposited on NaCl substrate at 10 mTorr Argon
 - Nanocrystalline films of 400Å thickness
 - Composition variant: 100% Pt, Pt-1Au, Pt-3Au, Pt-10Au
- TEM Sample Prep
 - Float off technique onto 300 mesh Mo grids
- Gatan heating holder in JEOL 2100 TEM
 - Rapid anneal to 300°C
 - Ramp anneal from 300 - 800°C, 50 mins

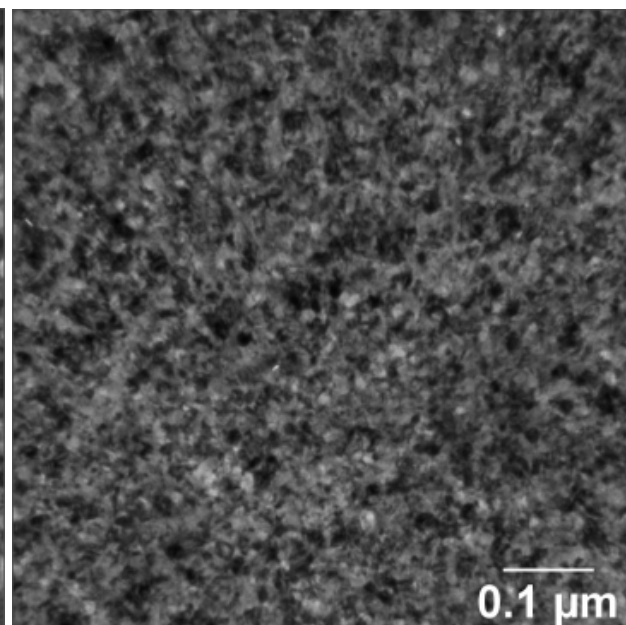
As-Deposited Nanocrystalline Pt-Au Alloys



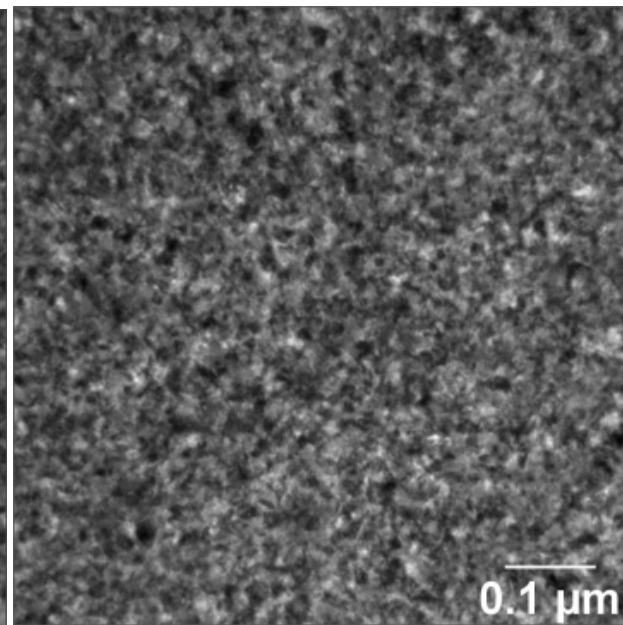
Pt



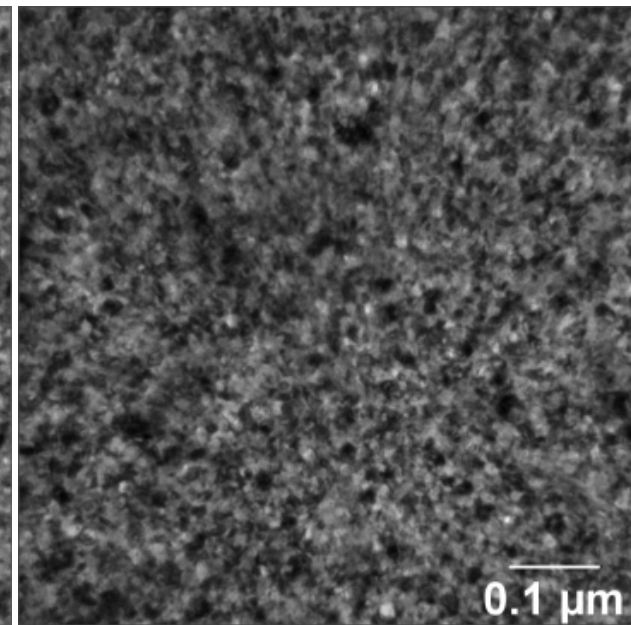
Pt-1Au



Pt-3Au



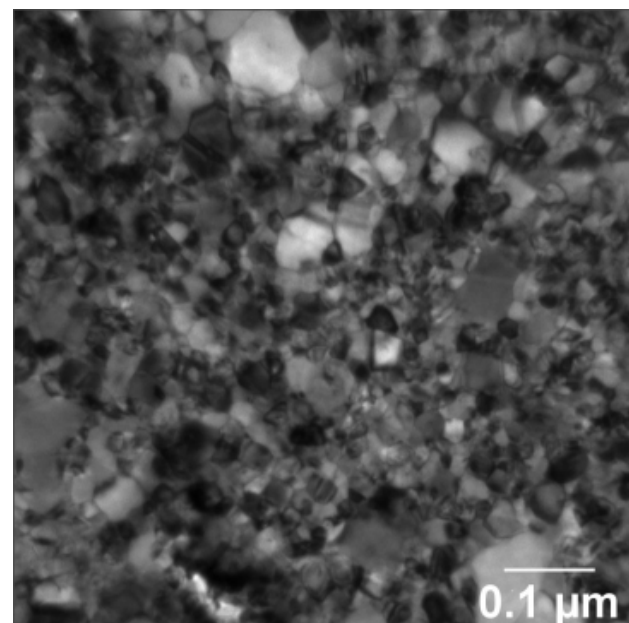
Pt-10Au



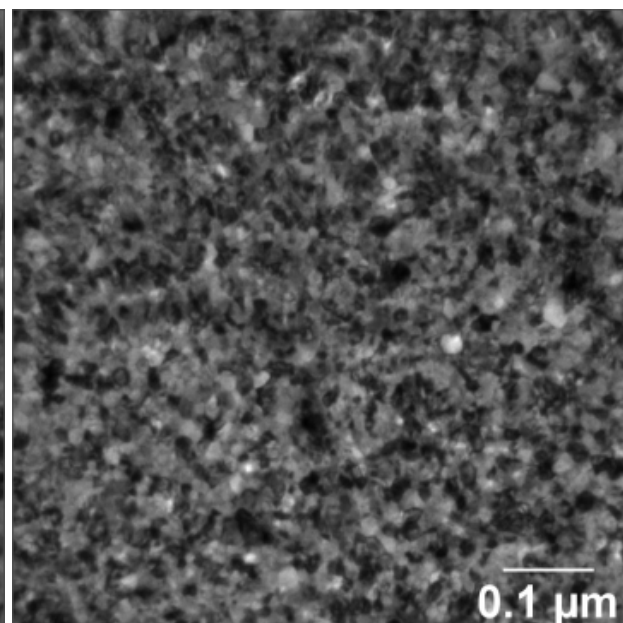
After Rapid Anneal to 300°C



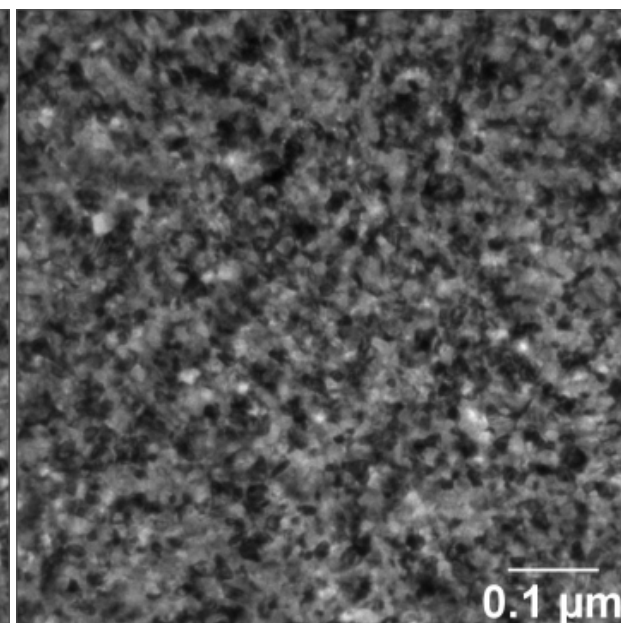
Pt



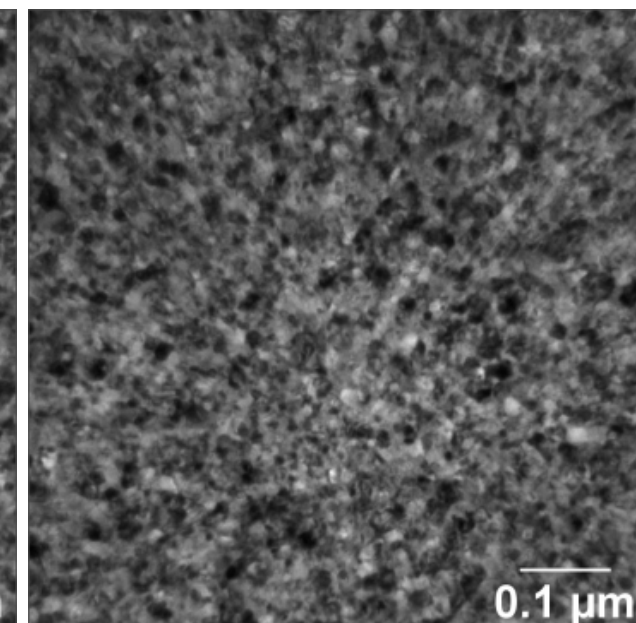
Pt-1Au



Pt-3Au



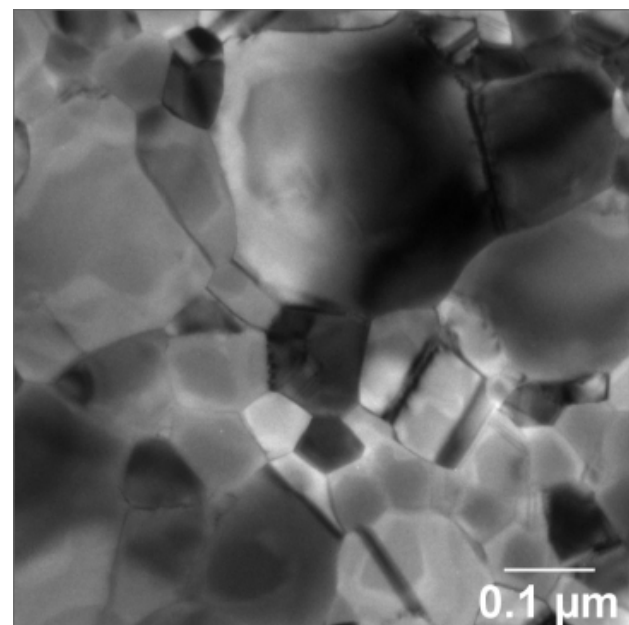
Pt-10Au



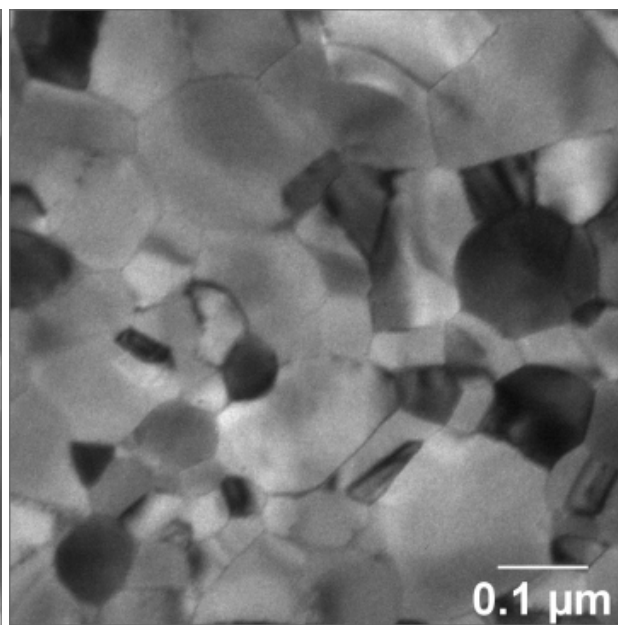
After Ramp Anneal: 300°C - 800°C, 50 mins, 10°C per min



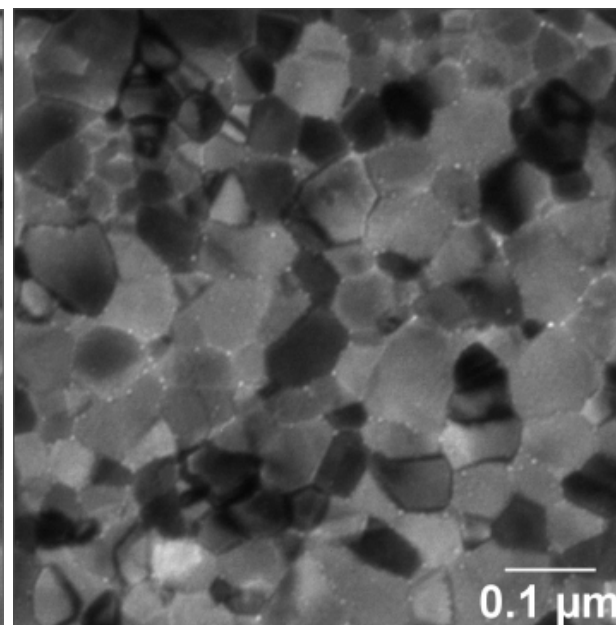
Pt



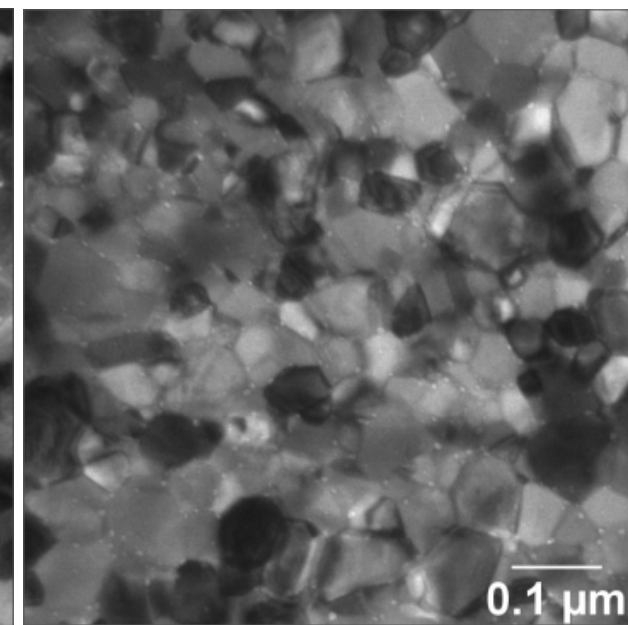
Pt-1Au



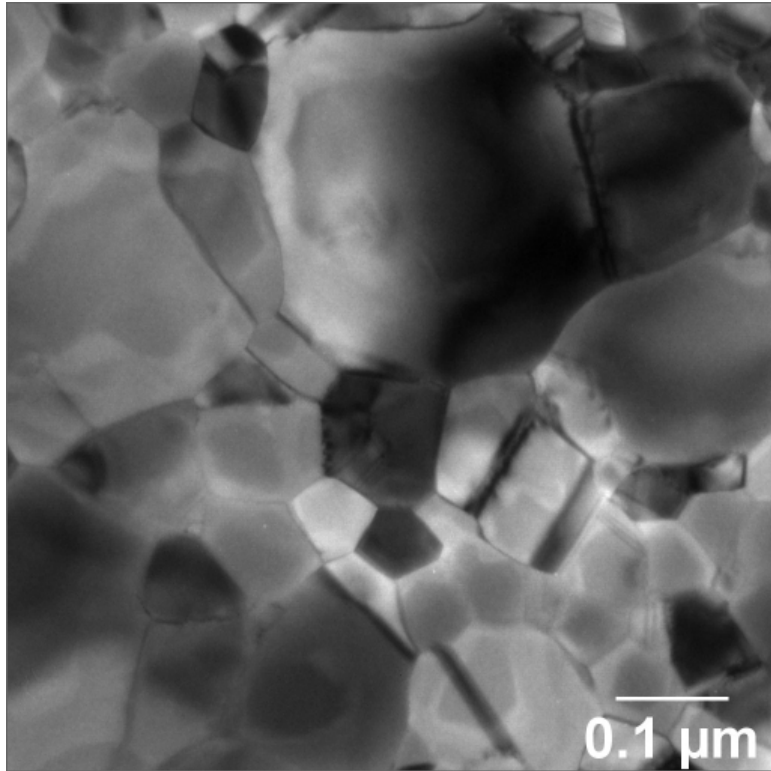
Pt-3Au



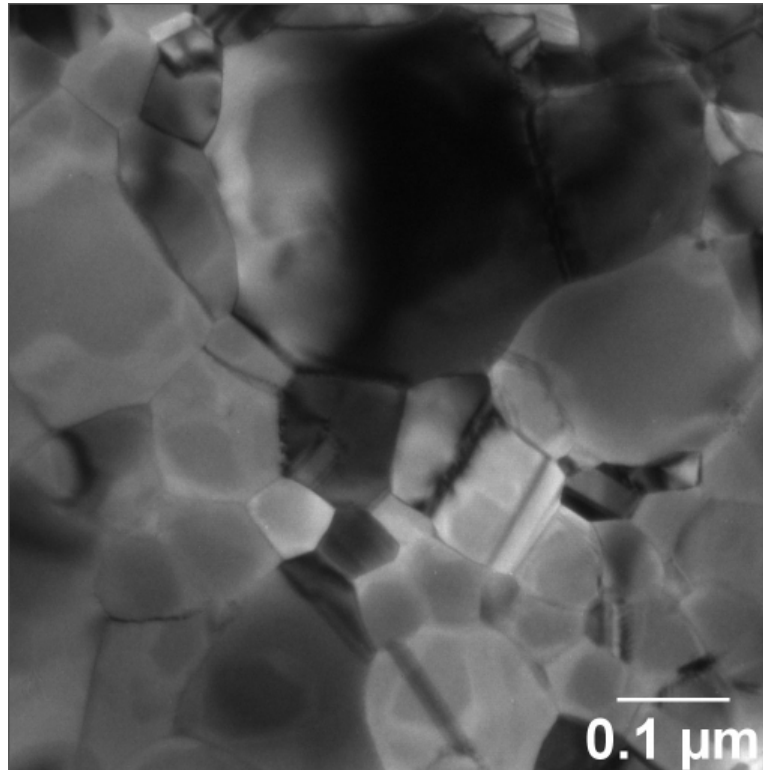
Pt-10Au



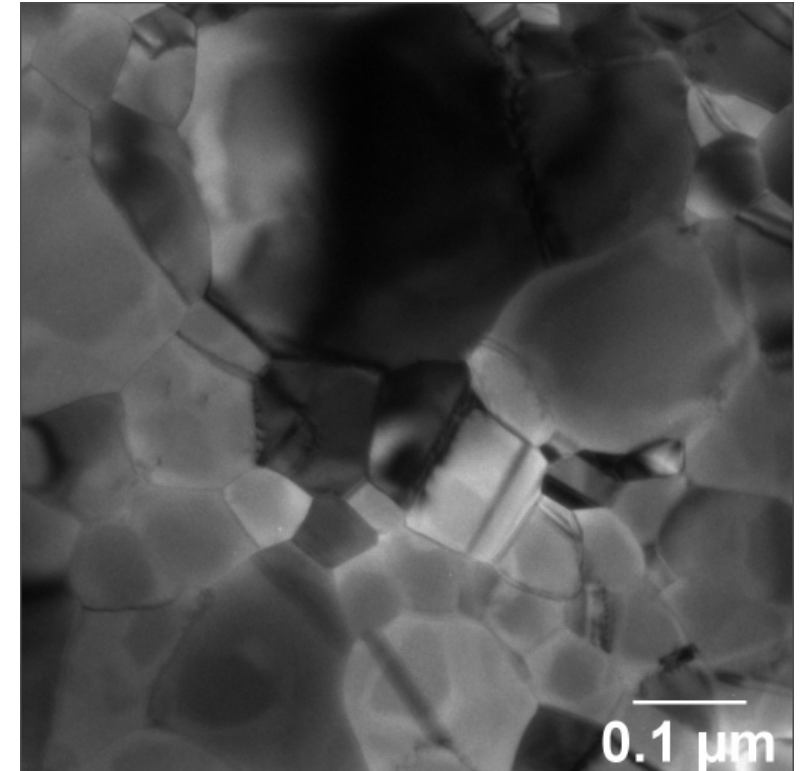
0 min

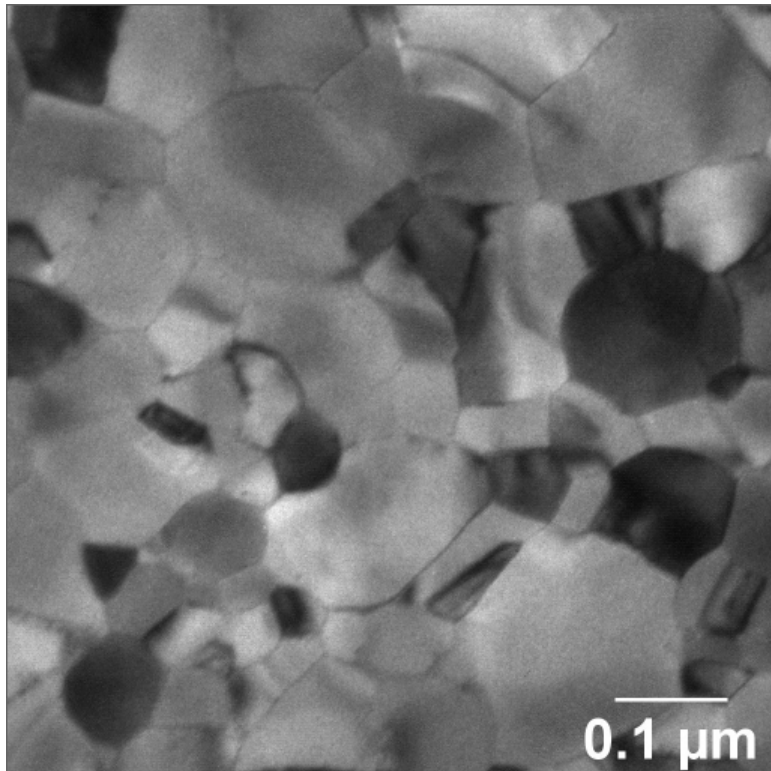
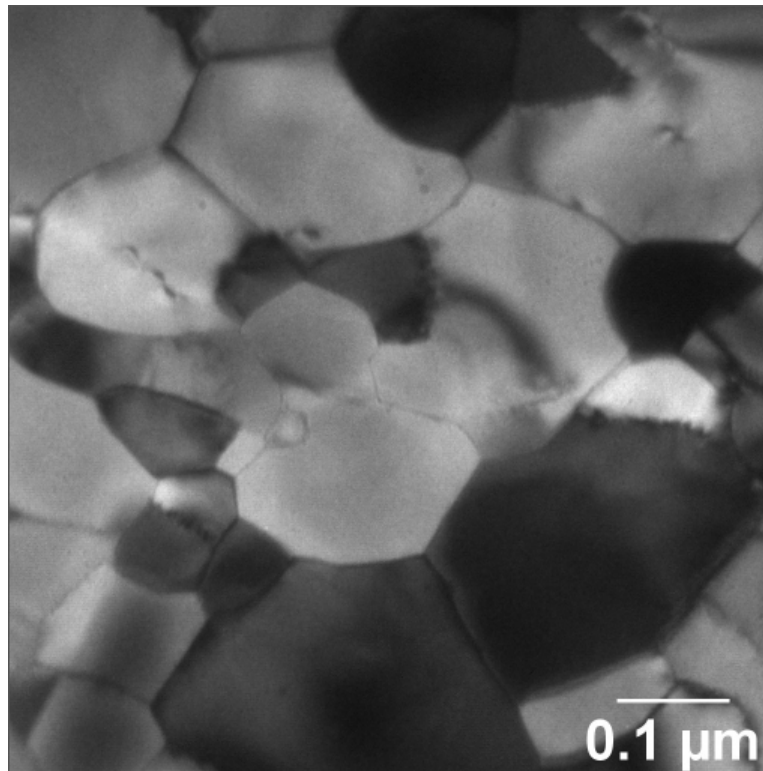
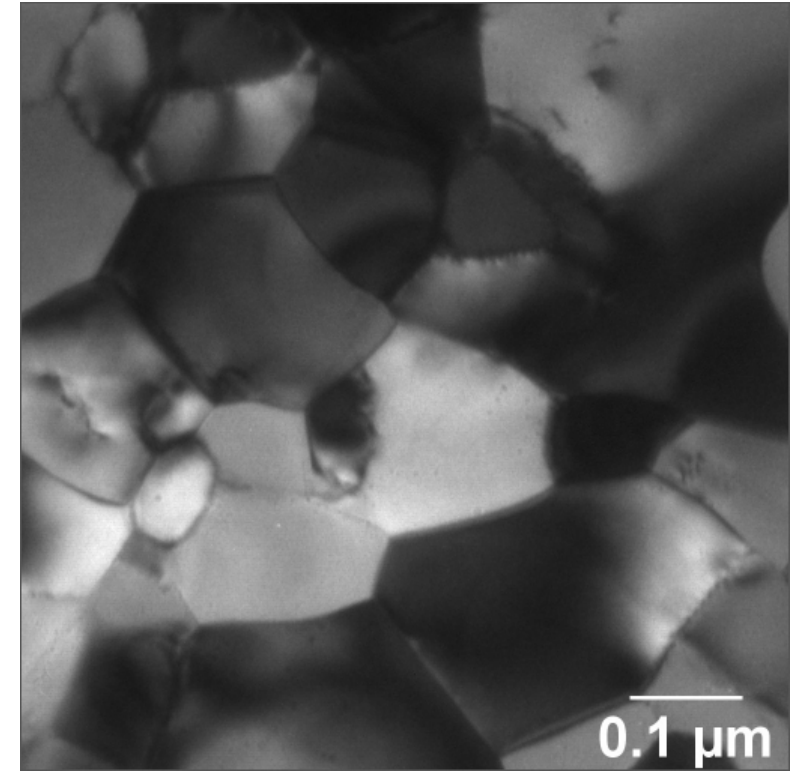


5 min

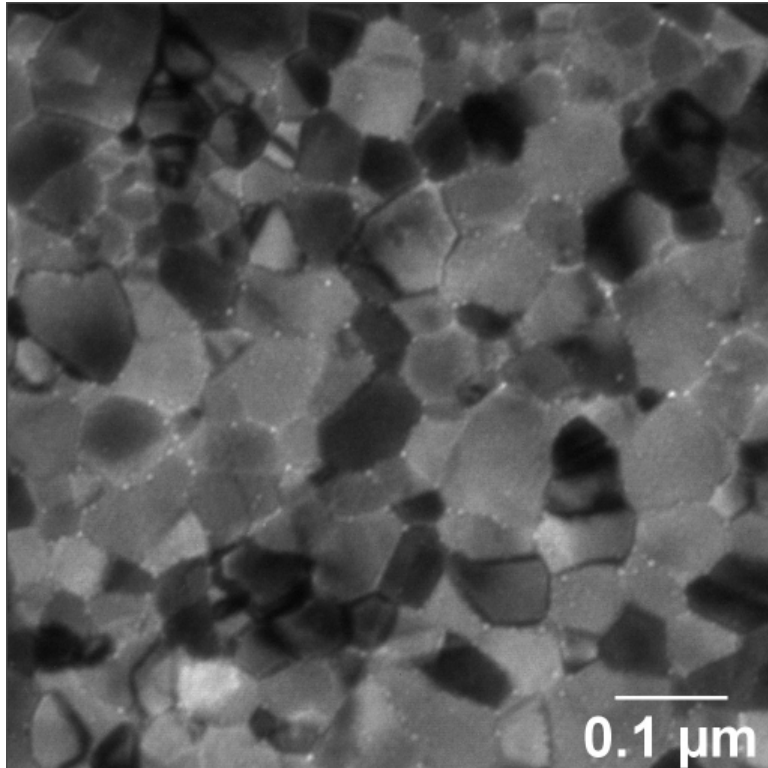


10 min

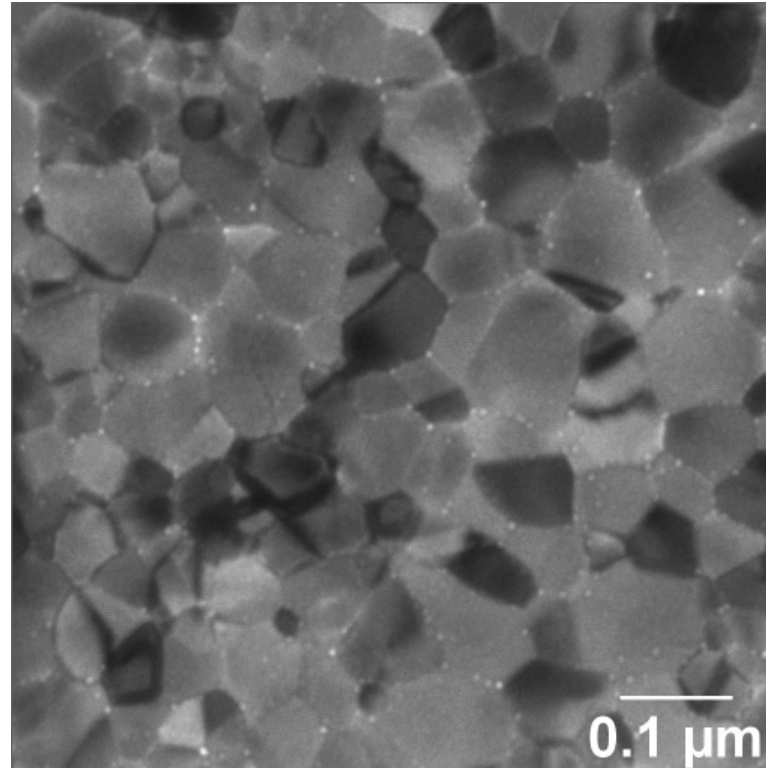


0 min**5 min****10 min**

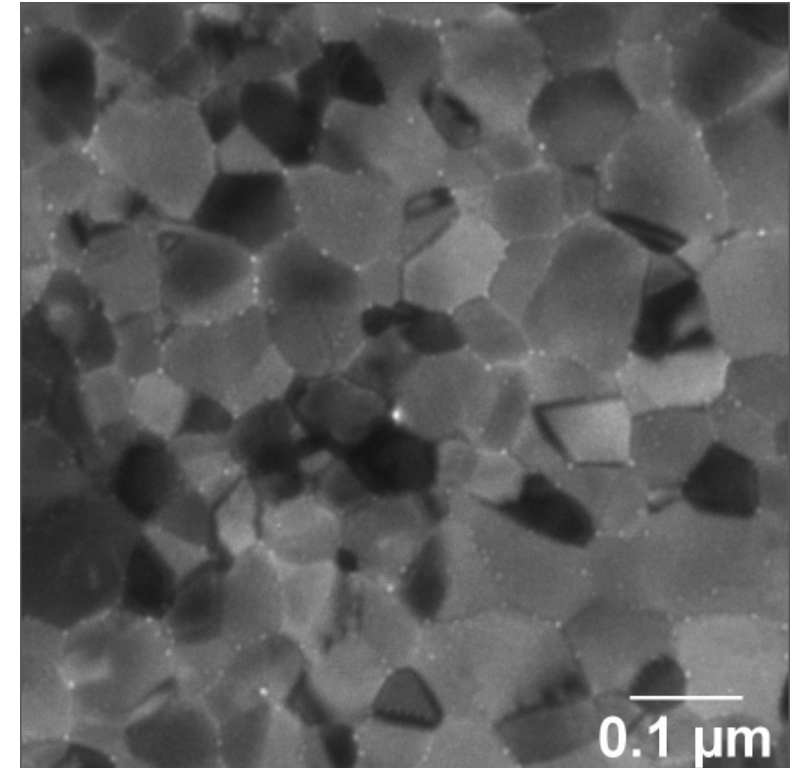
0 min



5 min



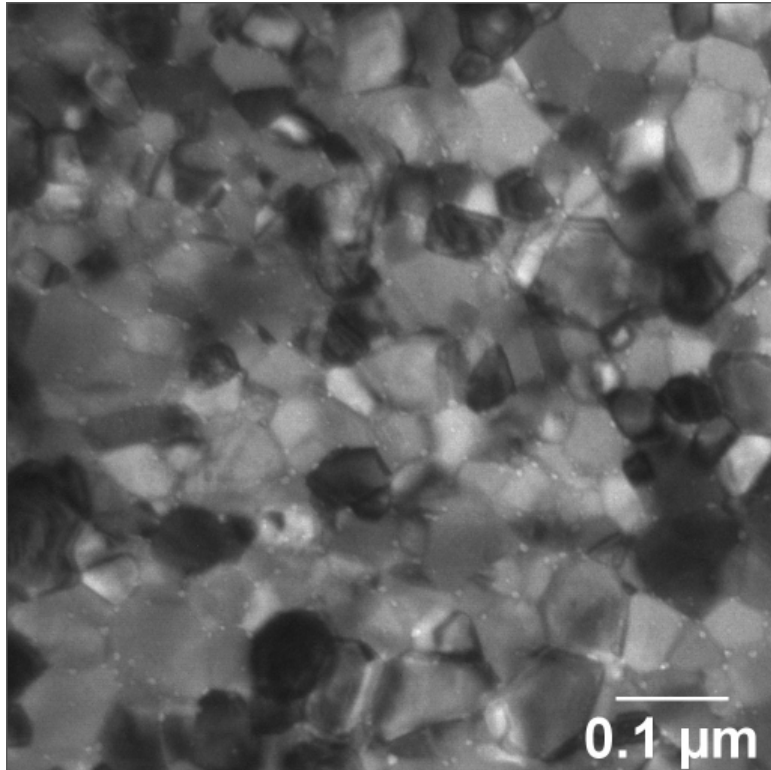
10 min



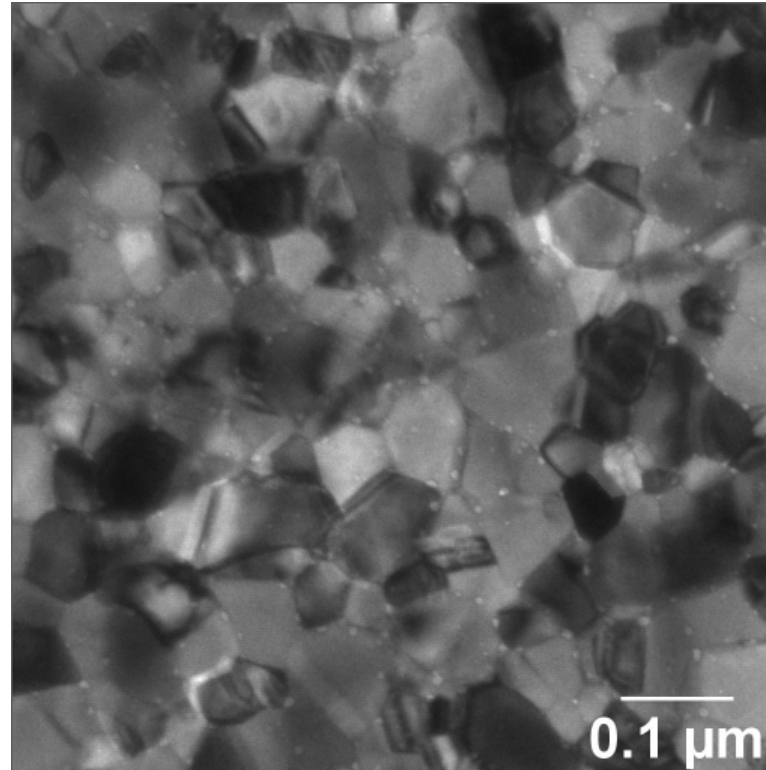
9 | Pt-10Au 10 min Hold at 800°C



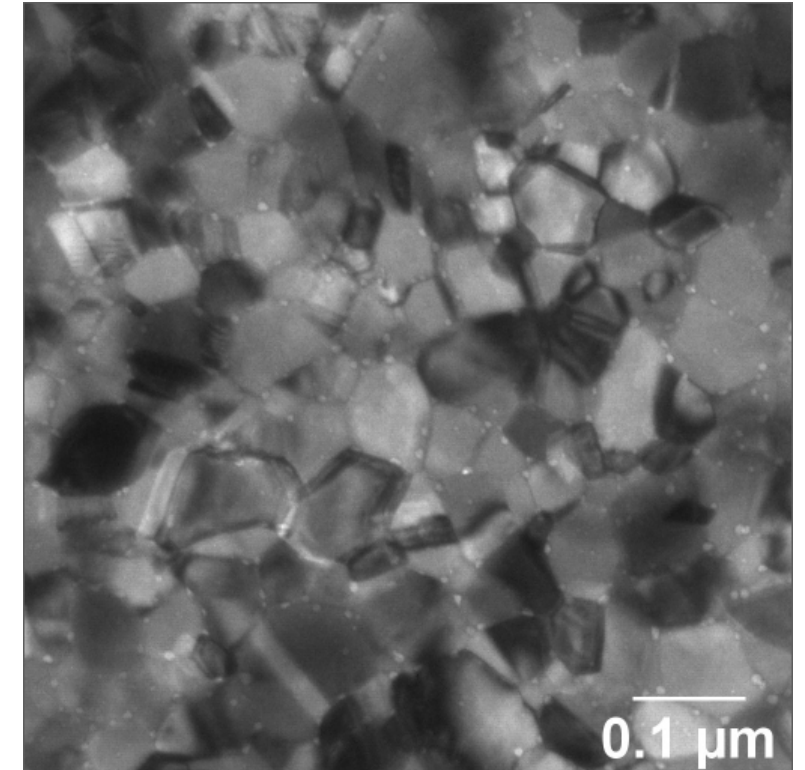
0 min



5 min



10 min



All 10 min Hold at 800°C

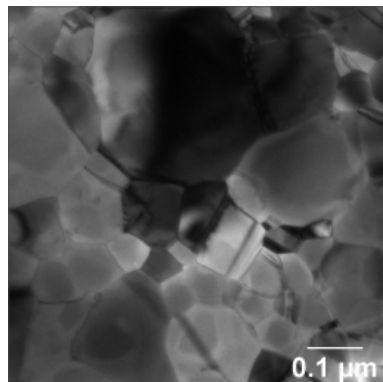
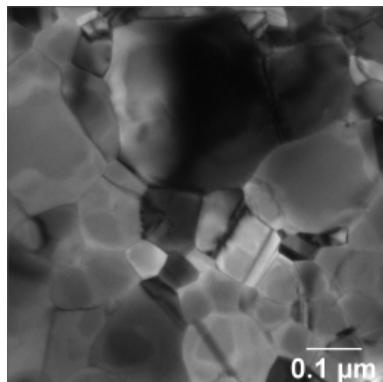
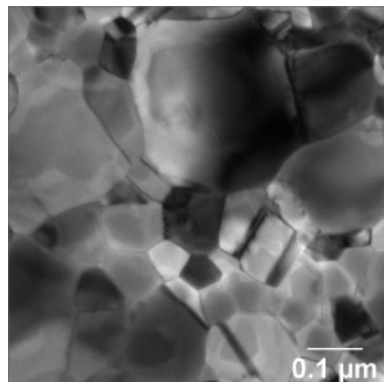


0 min

Pt

5 min

10 min

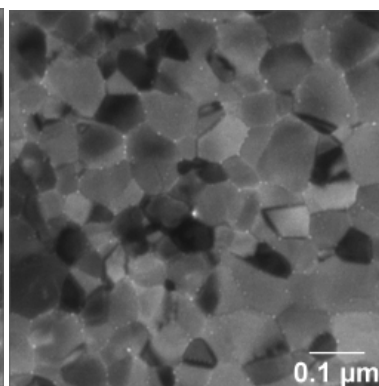
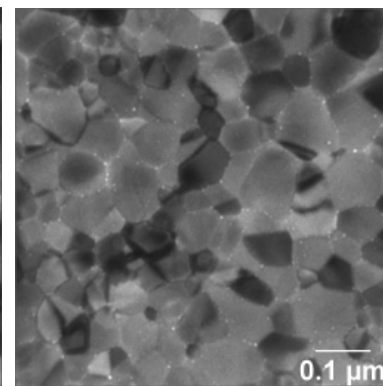
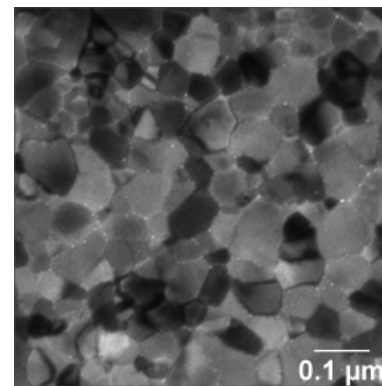


0 min

Pt-3Au

5 min

10 min

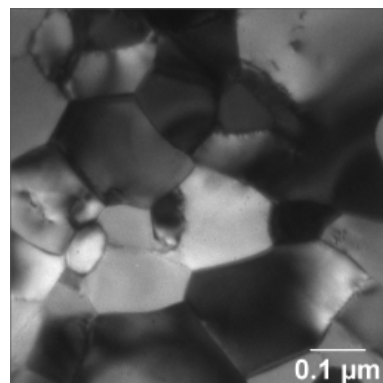
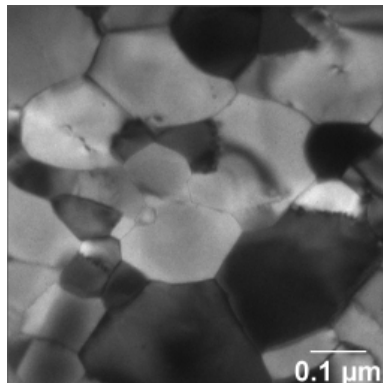
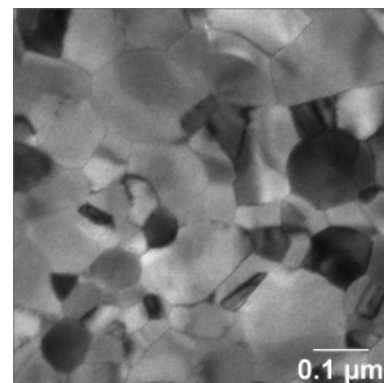


0 min

Pt-1Au

5 min

10 min

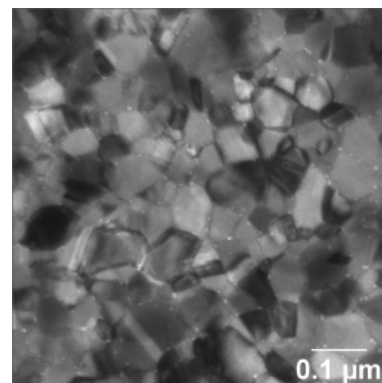
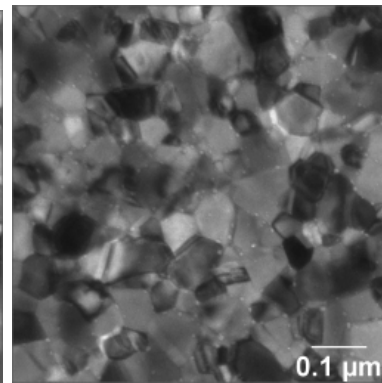
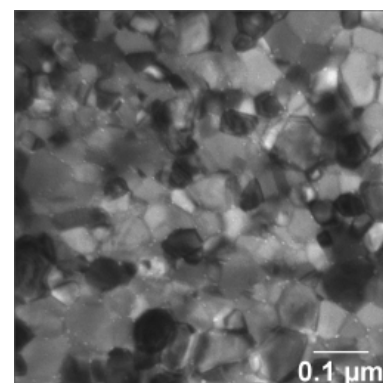


0 min

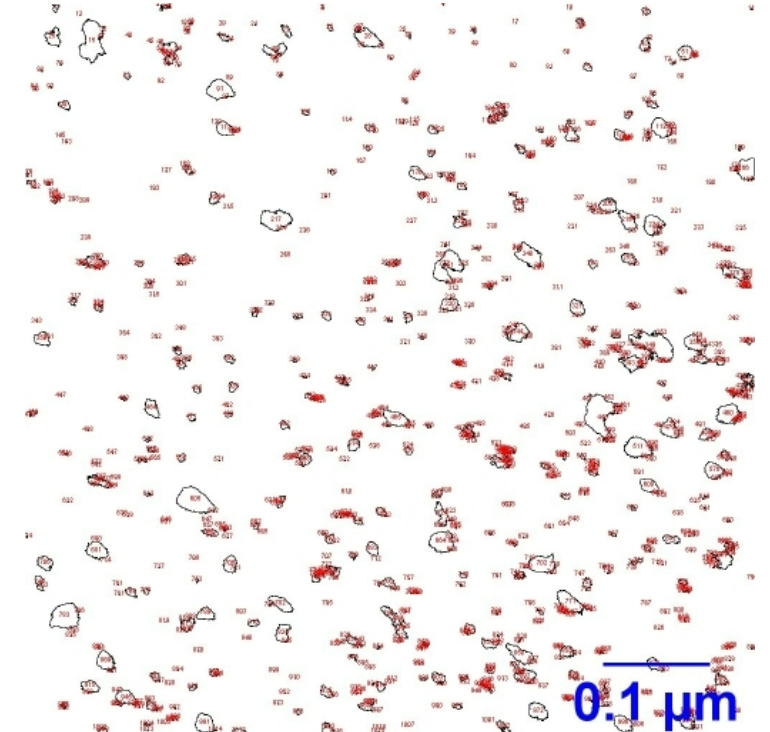
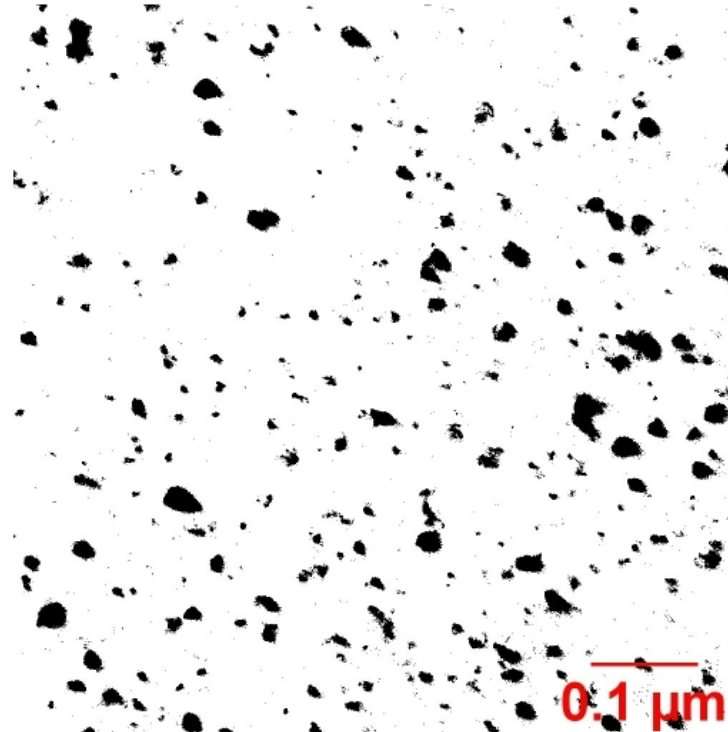
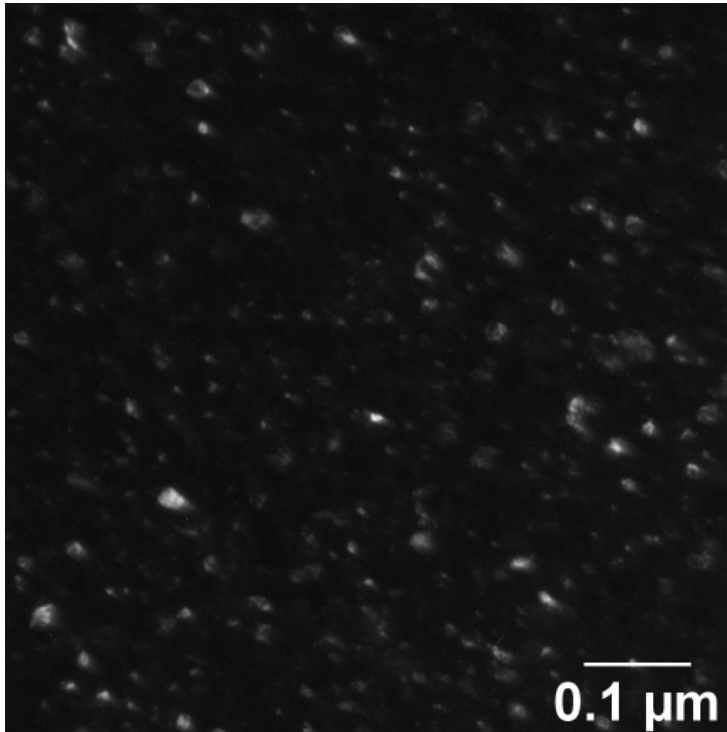
Pt-10Au

5 min

10 min

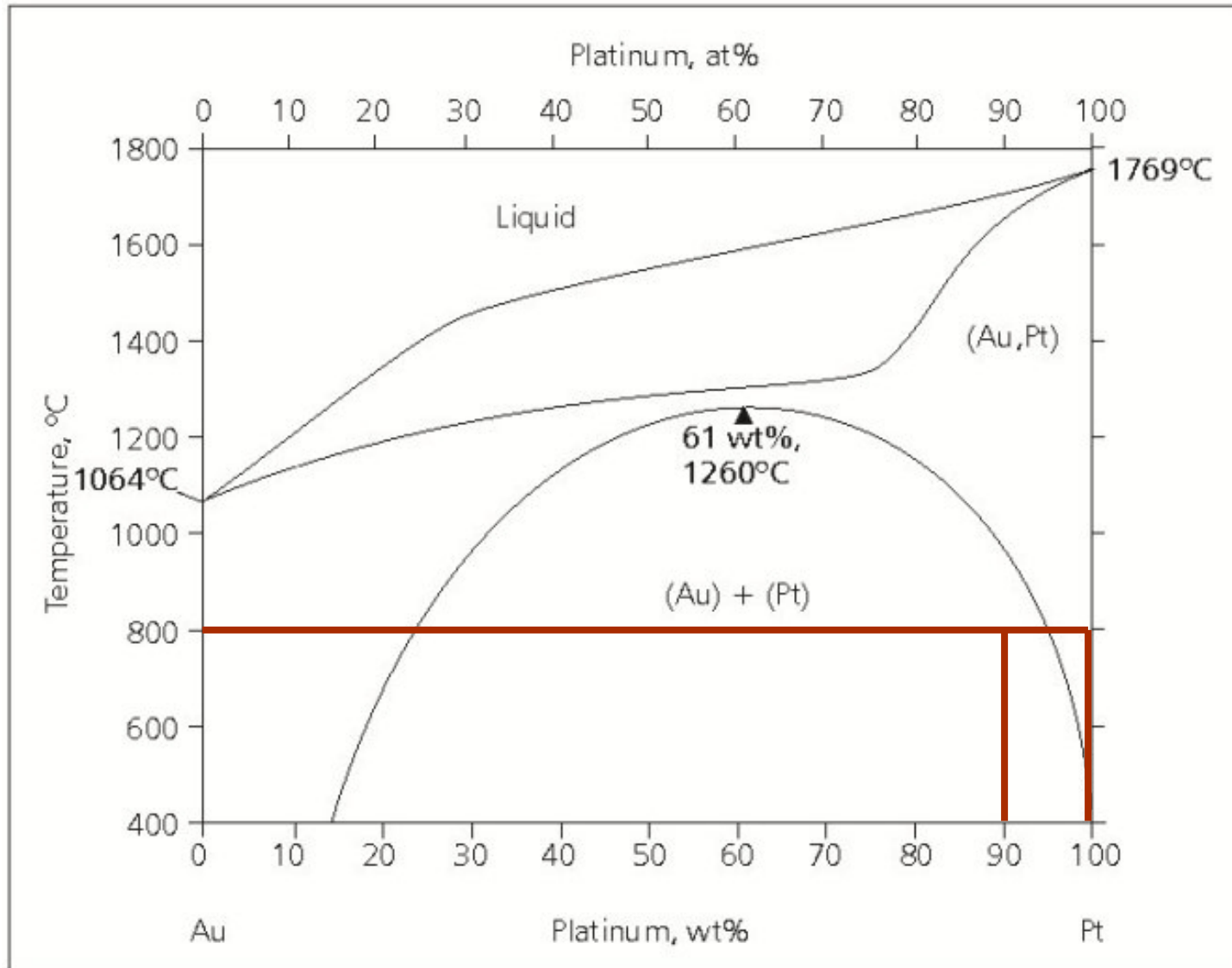


Analyzing Grain Size From Dirty DF: Particle Size in Fiji ImageJ



Average Grain Size: 15.5 nm²

Pt + Au segregation within tested temperature regimes?



- DP potentially inconclusive
 - Pt and Au both FCC structure
- Interest in EDS?