ELECTRON WAVES AND NANO-MAGNETISM
CONTROLLING MATTER AT THE LEVEL OF INDIVIDUAL ATOMS

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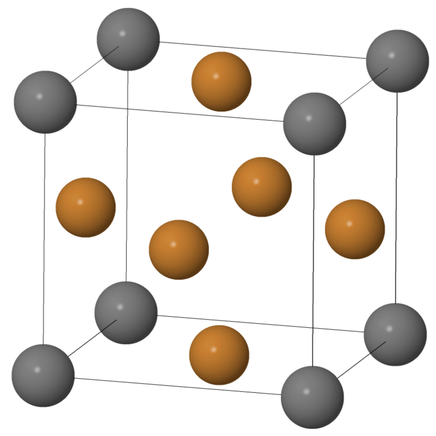
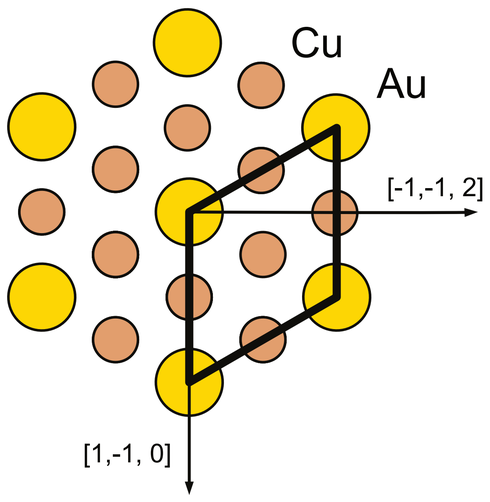
Metallic alloys can offer an interesting alternative to conventionally utilized pure metal substrates due to a larger flexibility in the effective lattice parameter. One of the candidates is the binary alloy Cu_3Au, that has been recently employed to grow large insulating nitride islands[1].



[1] Gobeil et al., Surface Science, 2018

$Cu_3Au(111)$ ORDERED/DISORDERED PHASE

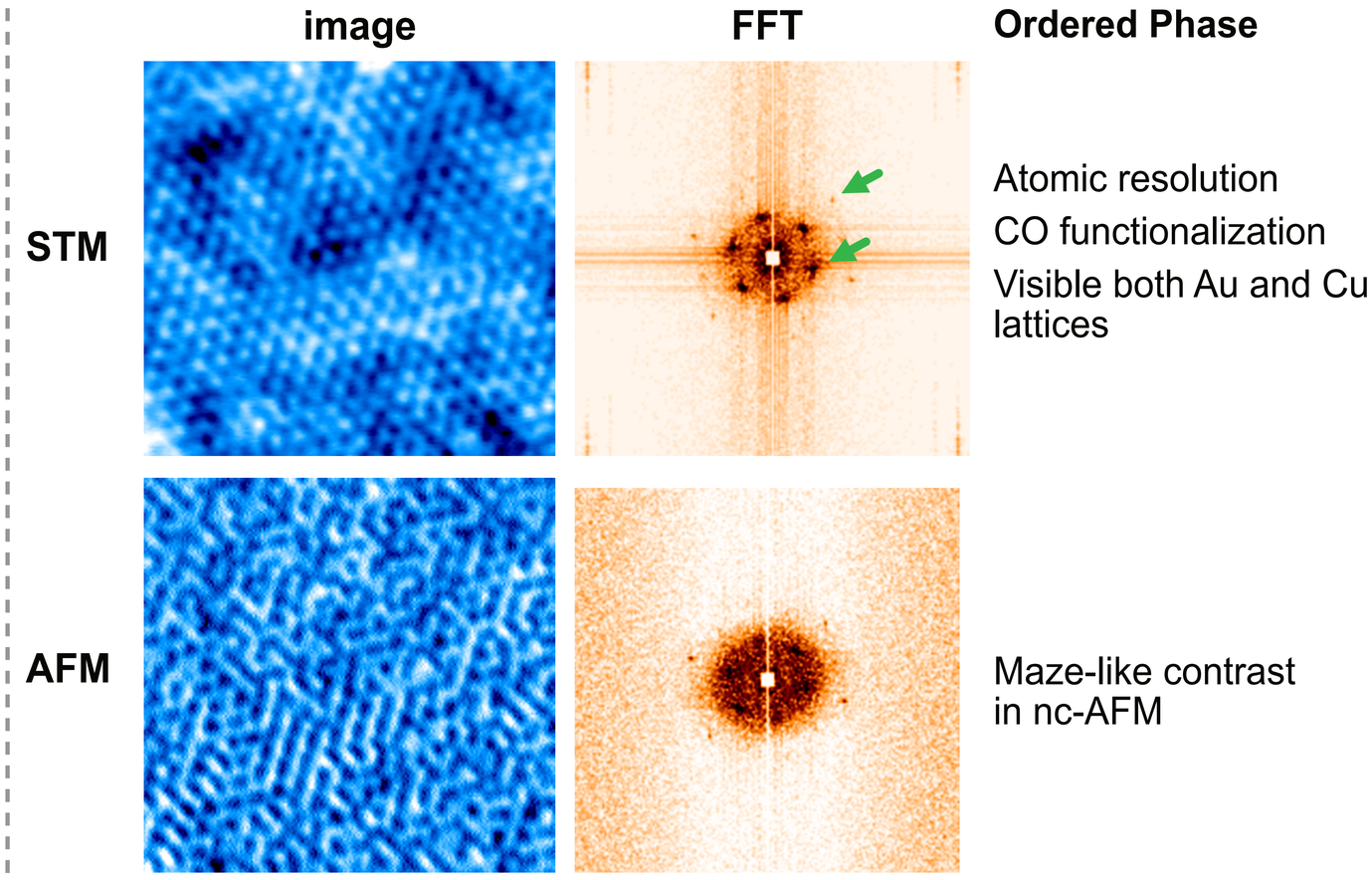


$Cu_3Au(111)$ surface

- First order order–disorder phase transition at **390 ºC**
- Disordered = randomly distributed atoms
- Ordered = Arranged Au atoms
- Band back folding due to new BZ

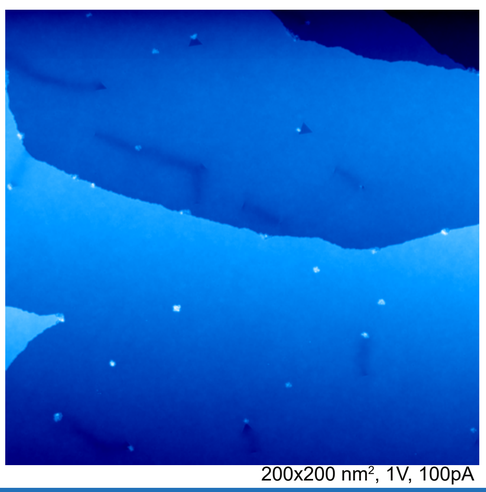
Preparation:

1. Ar^+ sputtering + annealing to 600 ºC
2. 1h annealing above 390ºC + fast cooling **(DISORDERED)**
3. 15h+ annealing below 390ºC **(ORDERED)**

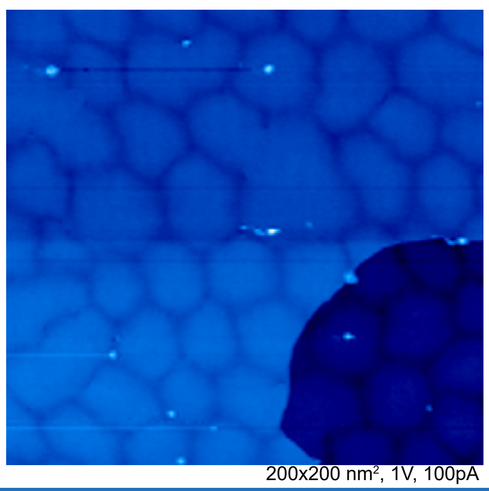


Overview scans showing domain growth depending on cooling dynamics,

lattice ~ 40 nm



200x200 nm², 1V, 100pA



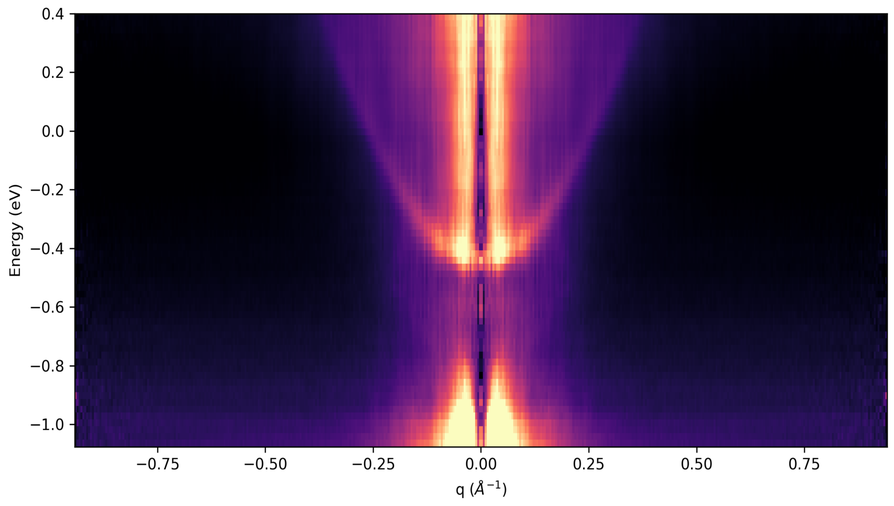
200x200 nm², 1V, 100pA

Surface State Dispersion

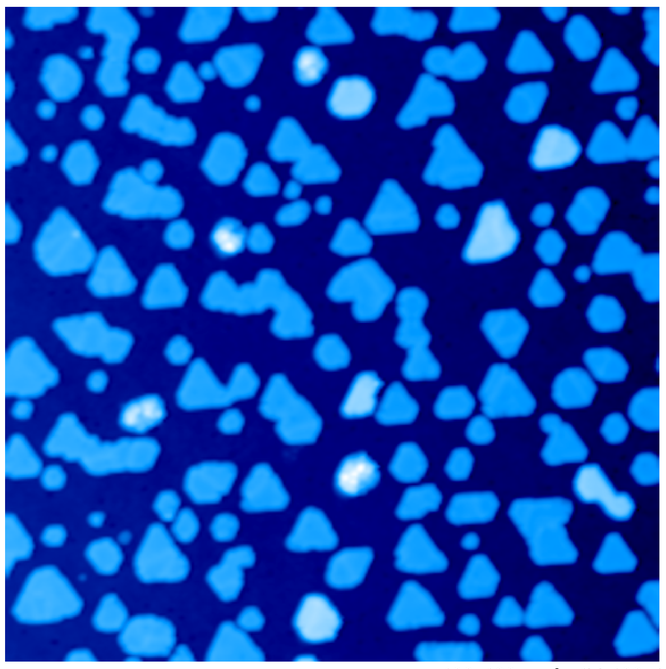
QPI mapping

Scattering enhanced with CO molecules

Band backfolding not visible (too high in energy)



COBALT ISLAND GROWTH $Cu_3Au(111)$



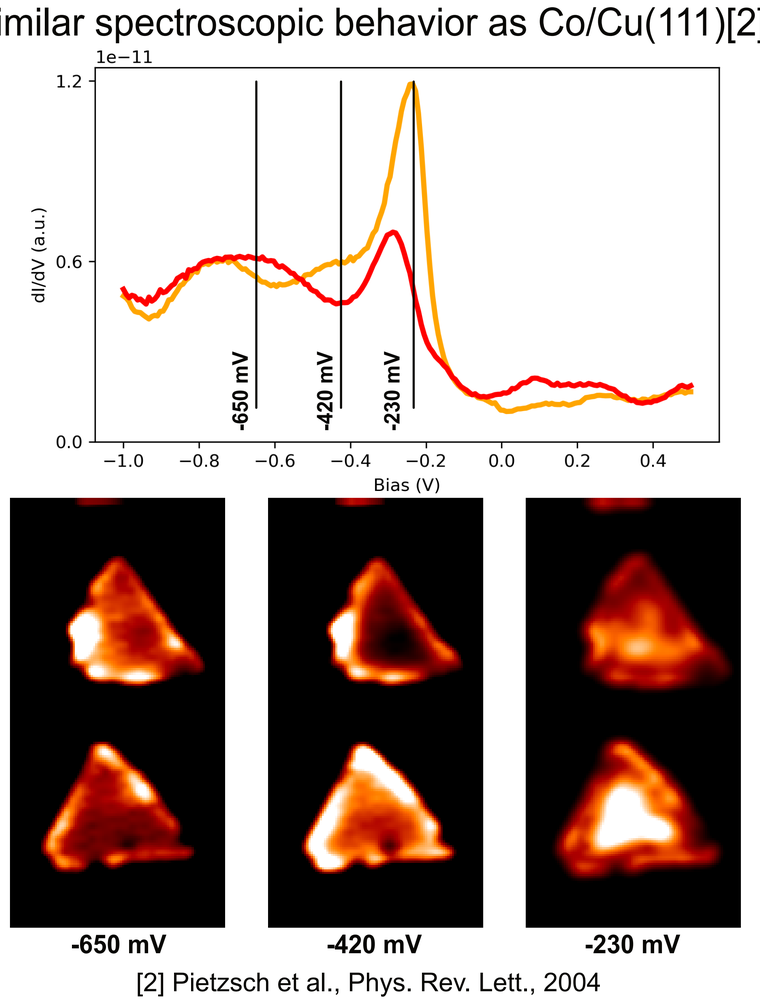
100x100 nm², -1V, 100pA

- ▶5% lattice mismatch
- ▶Growth on both ordered and disordered phase
- ▶Cobalt deposition at surface @ 160 ºC
- ▶Post annealing
- ▶**No strong** alloying/intermixing at RT
- ▶Preferential stacking orientation

Spin polarized dI/dV

Tips: controlled dipping into Co islands

Similar spectroscopic behavior as Co/Cu(111)[2]



[2] Pietzsch et al., Phys. Rev. Lett., 2004

Take-home for $Cu_3Au(111)$:

- ▷Playground for electronic structure modification (scattering on new BZ boundaries and domain walls)
- ▷Substrate for growth of magnetic Co islands with less stacking faults and lower intermixing (higher stability at RT)