Exploring a subsurface in metals with STM

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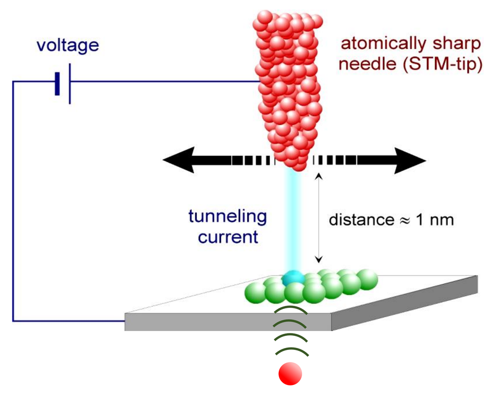
Intriduction

Text In spite of the common believe that the STM technique can be used exclusively for a surface analysis, actually it can also be applied for subsurface studies. The ability of the subsurface STM vision is illustrated with a simple metallic system – Co impurities [1] or sub-surface Co, Fe, Ar, Ne and He clusters [2,3] in a single-crystalline copper sample.

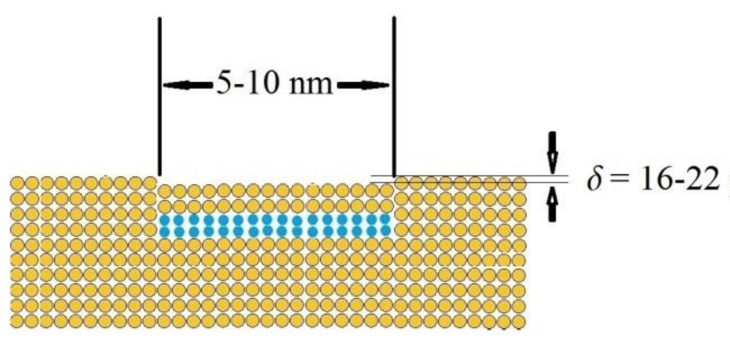
How to make it possible



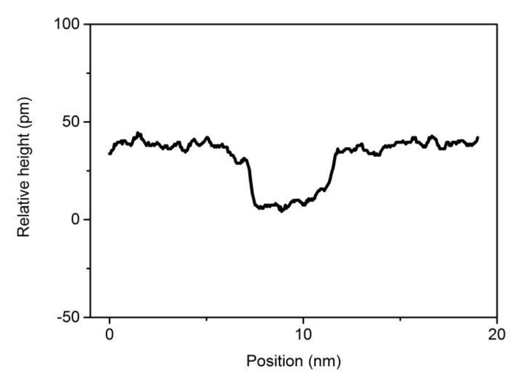
Subsurface atoms and clusters can induce

- Tinny surface deformation
- Deviation of LDOS of surface atoms
- Oscillation of bulk LDOS due to electron confinement

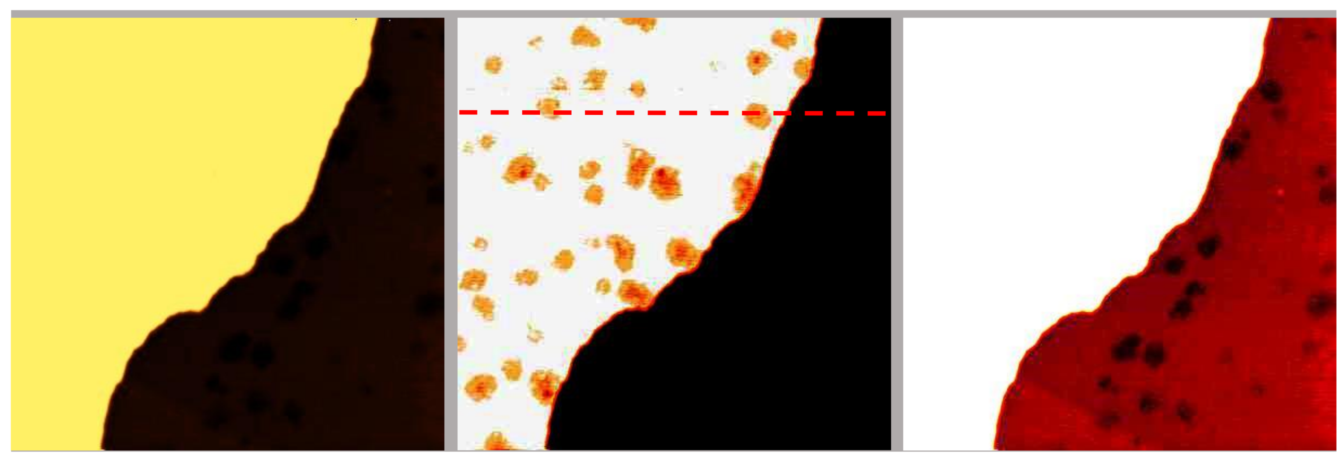
1. Tinny surface deformations

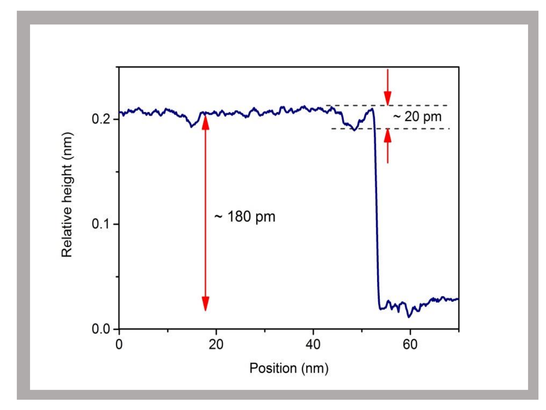


Mismatch of crystalline lattices of substrate and impurity atoms or embedded nanocluster .



Deformation of 5…50 pm

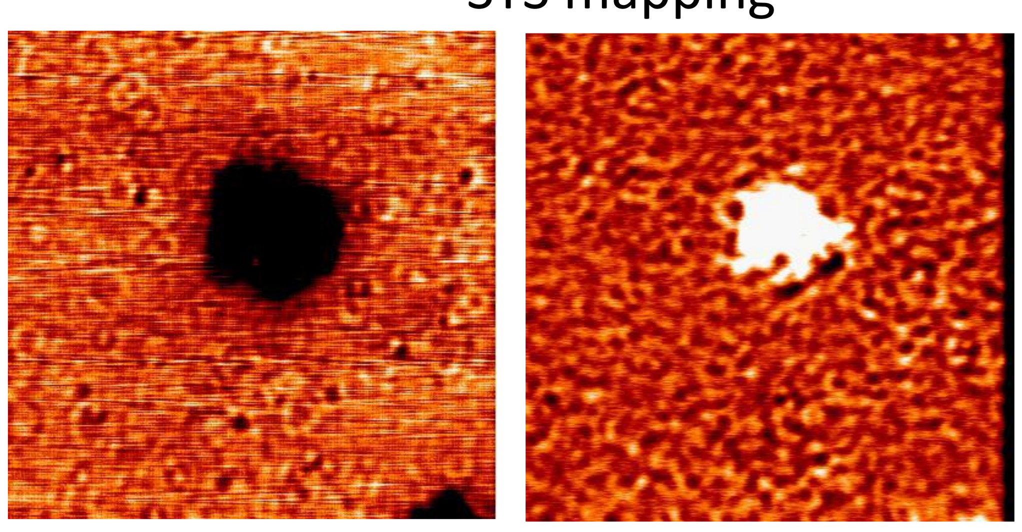




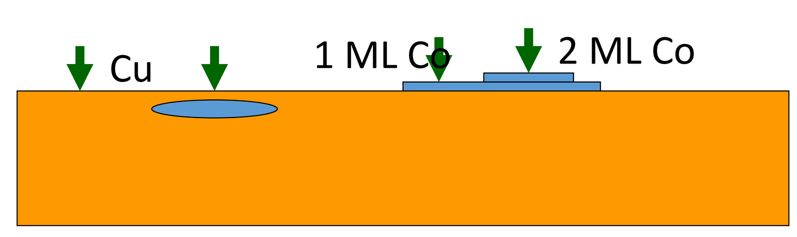
Co nanoclusters embedded bellow Cu(001) surfce, 75 x 75 nm [2].

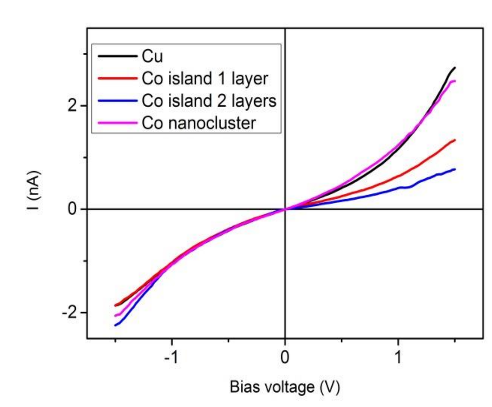
2. Deviation of LDOS of surface atoms

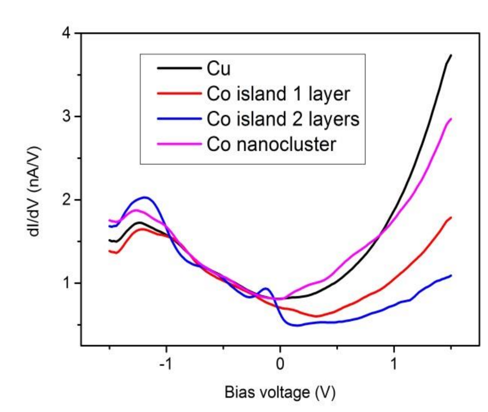
relief STS mapping



20 x 20 nm

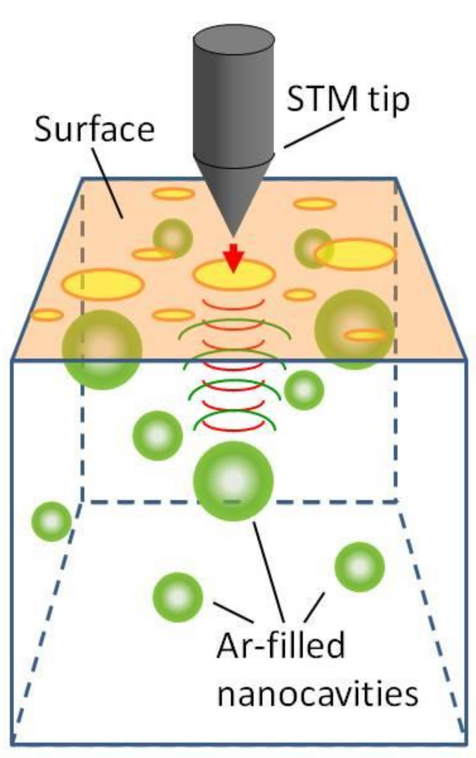


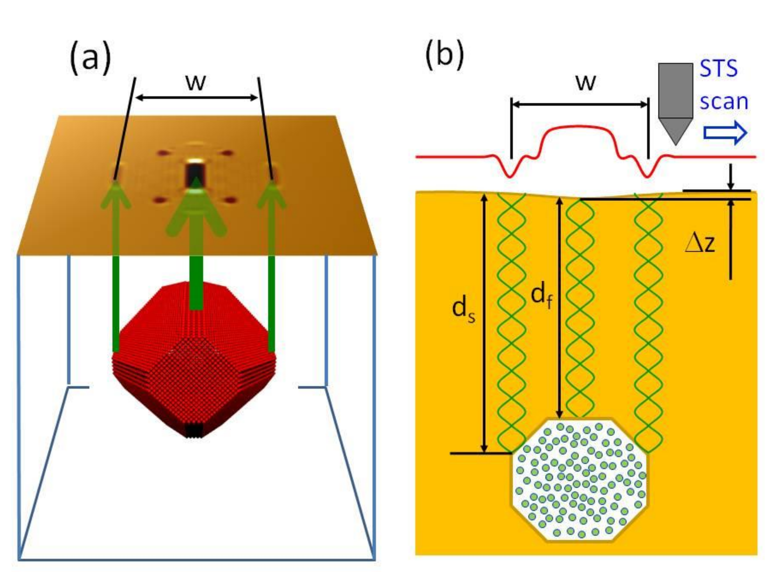


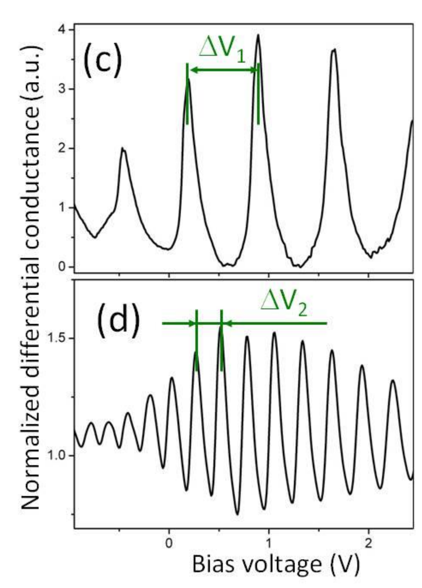


Can fill the subsurface clusters only for 1 nm deep

3. Oscillation of bulk LDOS due to electron confinement

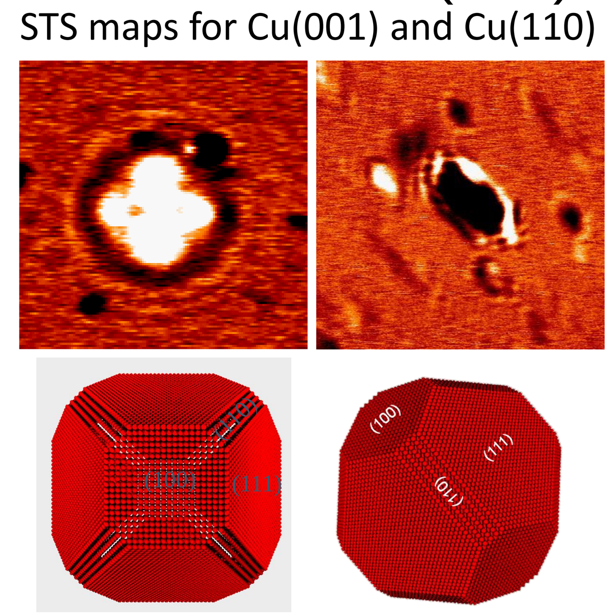






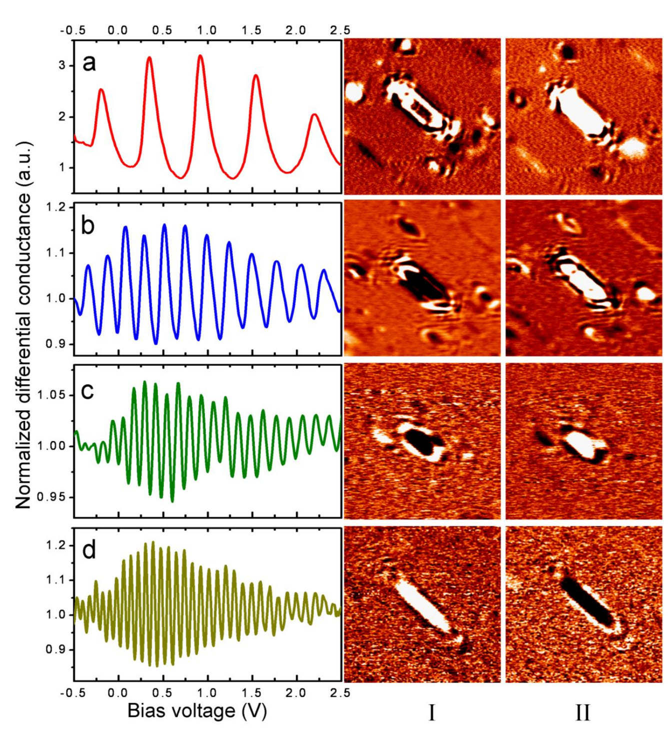
Ar cluster in Cu(001)

STS maps for Cu(001) and Cu(110)

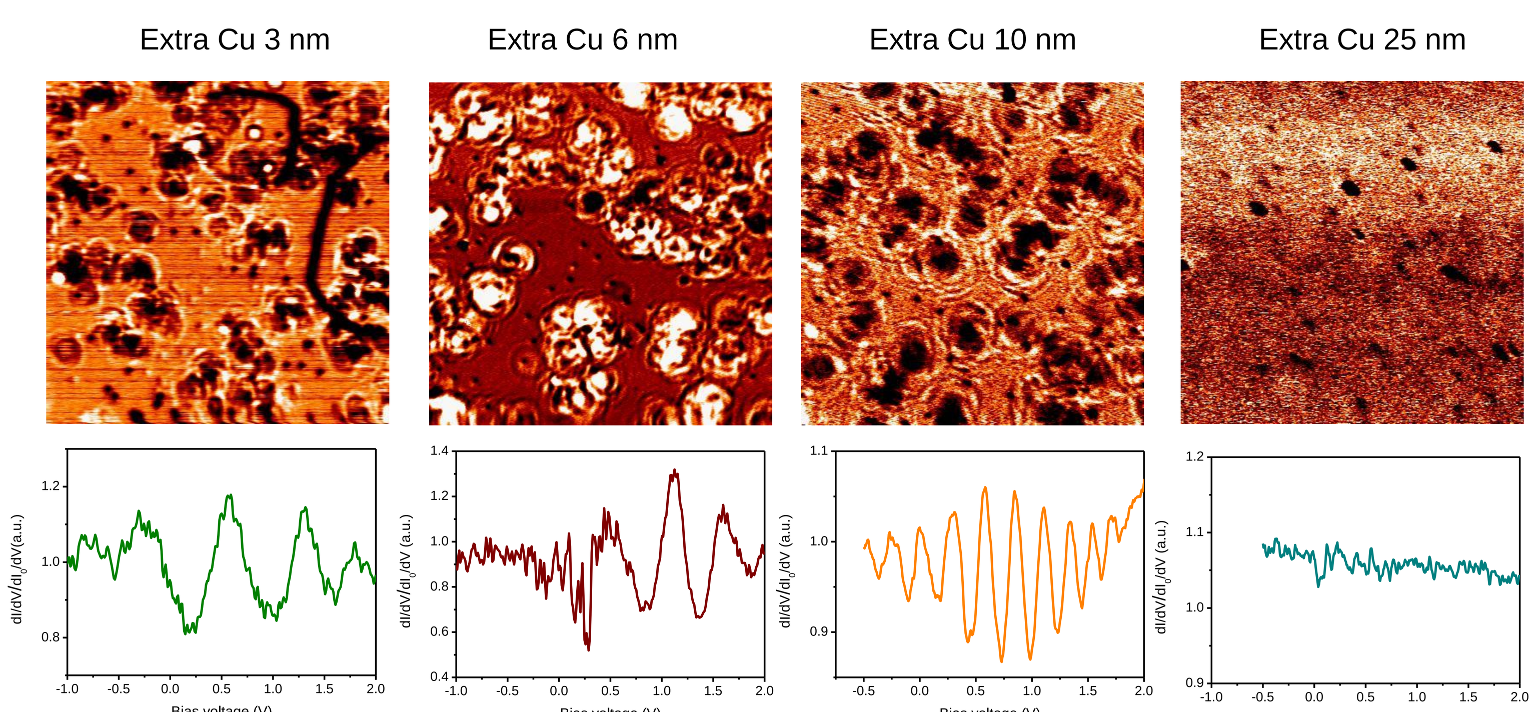


Corresponding size and shape of the facetted nanocavities in Cu. The last atomic layer at the interface is shown.

Ar cluster in Cu(110)



Co cluster in Cu(001)



Ar-filled nanocavities in copper can be observed up to 40 nm deep.

Co clusters in copper can be observed up to 20 nm deep. Similar results are obtained for Fe.

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