SFB 290 B3 Determination of Growth- and Structural Parameters of Single Crystal Metal- and Alloy Films

Structure and Energetics of Silver /Copper-Alloy Films on a Rhenium(0001) Surface

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Content:

- Introduction and motivation
- Results of the sub- Ag + Cu- bilayer Ag–TPD measurements
- Results of the LEED measurements
- Summary and future work

Main questions:

What is an alloy?

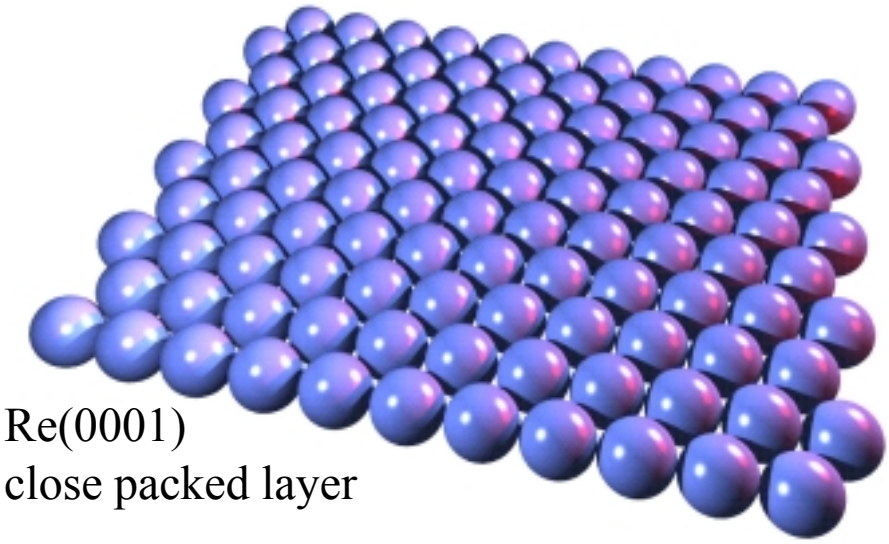
Why does the silver-copper 3D system have a wide miscibility gap?

Is it possible to overcome this gap and if yes, how?

An alloy is a mixture of metals.

Alloys can be a homogeneous solid solutions (mixed crystals) in which metal atoms are distributed statistically in the lattice.

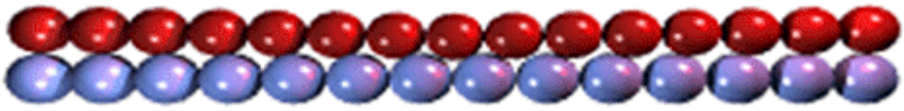
Usage of two-dimensionality and lattice registry for inducing alloying



Re(0001)
close packed layer

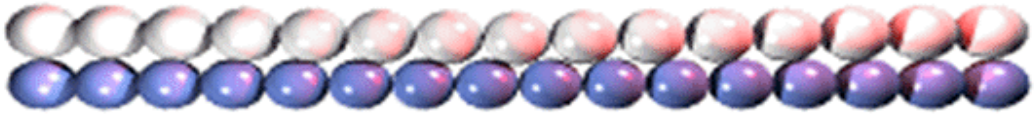
Compound	Nearest Neigh-bour Distance	Ratio of Radii
ReRe	276.1pm	100%
AgAg	288.9pm	105%
CuCu	255.6pm	93%
CuAg	272.2pm	98.6%

incommensurate, relaxed Cu/Re bilayer (experimental observed)



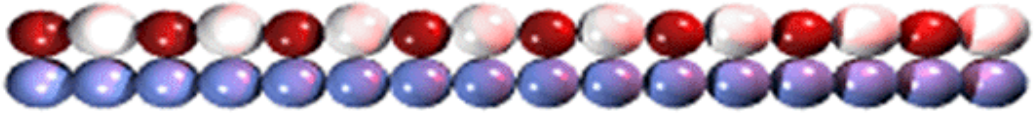
15 Cu
14 Re

incommensurate, relaxed Ag/Re bilayer (virtual)



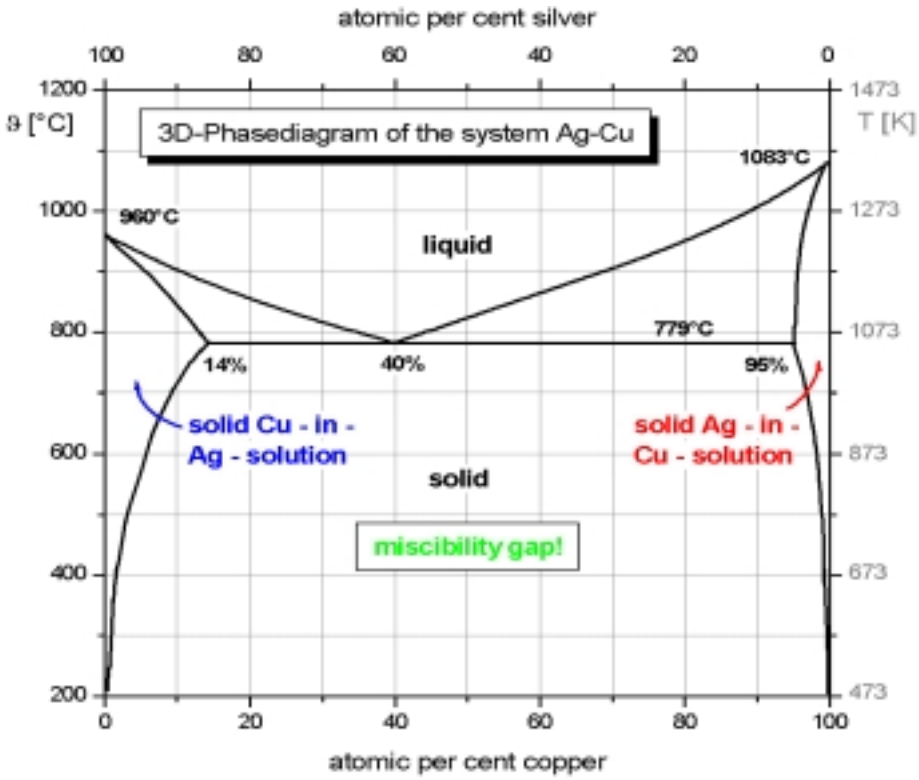
15 Ag
16 Re

commensurate, relaxed Ag+Cu/Re bilayer (hypotetical)



16 (Cu+Ag)
16 Re

The copper-silver bulk system



Requirements for mixed crystals:

Both metals must belong to the same lattice-type

silver: fcc, copper: fcc

The difference of radii has to be less than 15%

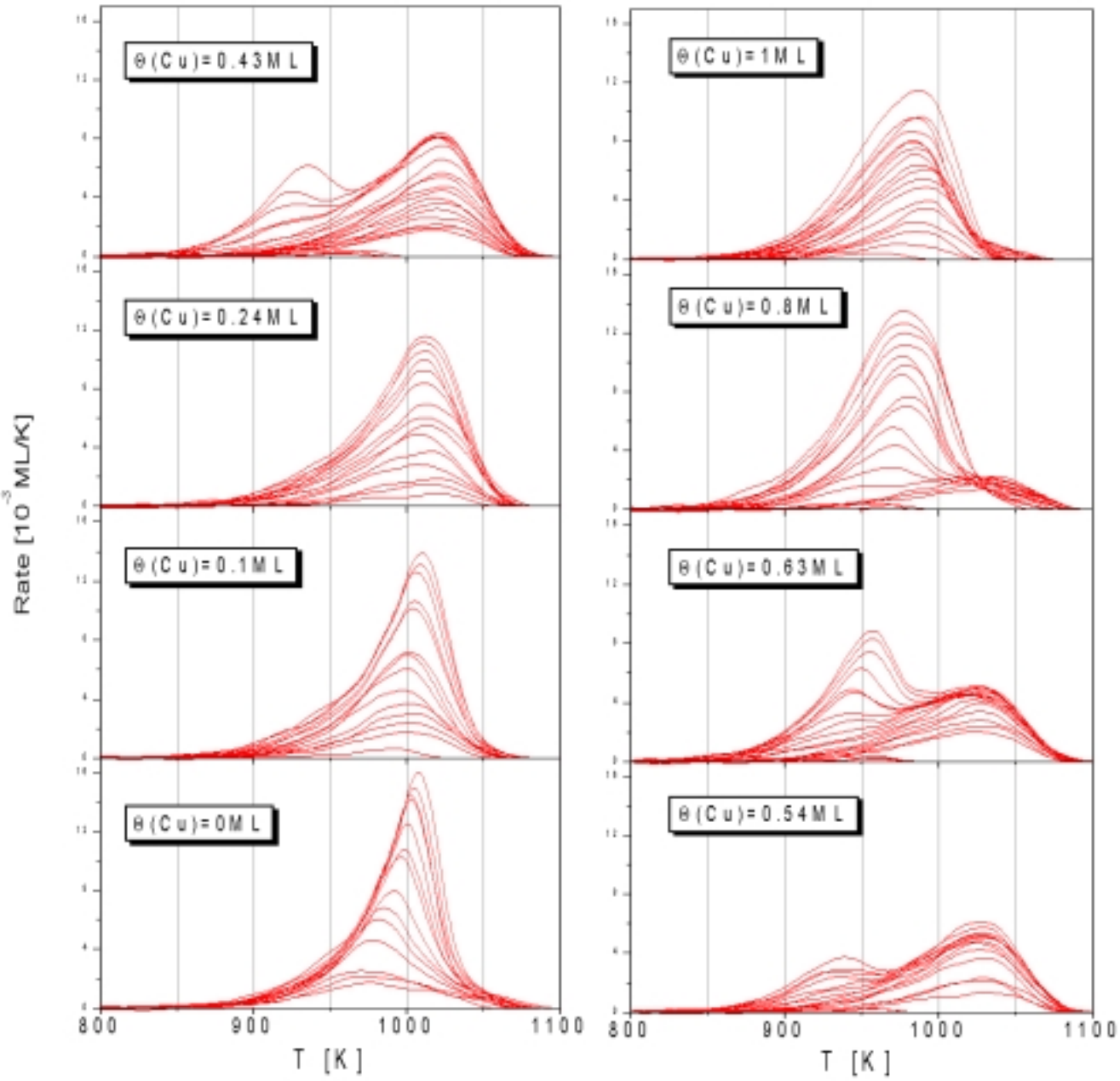
silver/copper: 13%

Both metals should exhibit similar electrone-gativities

silver: 1.93, copper 1.90

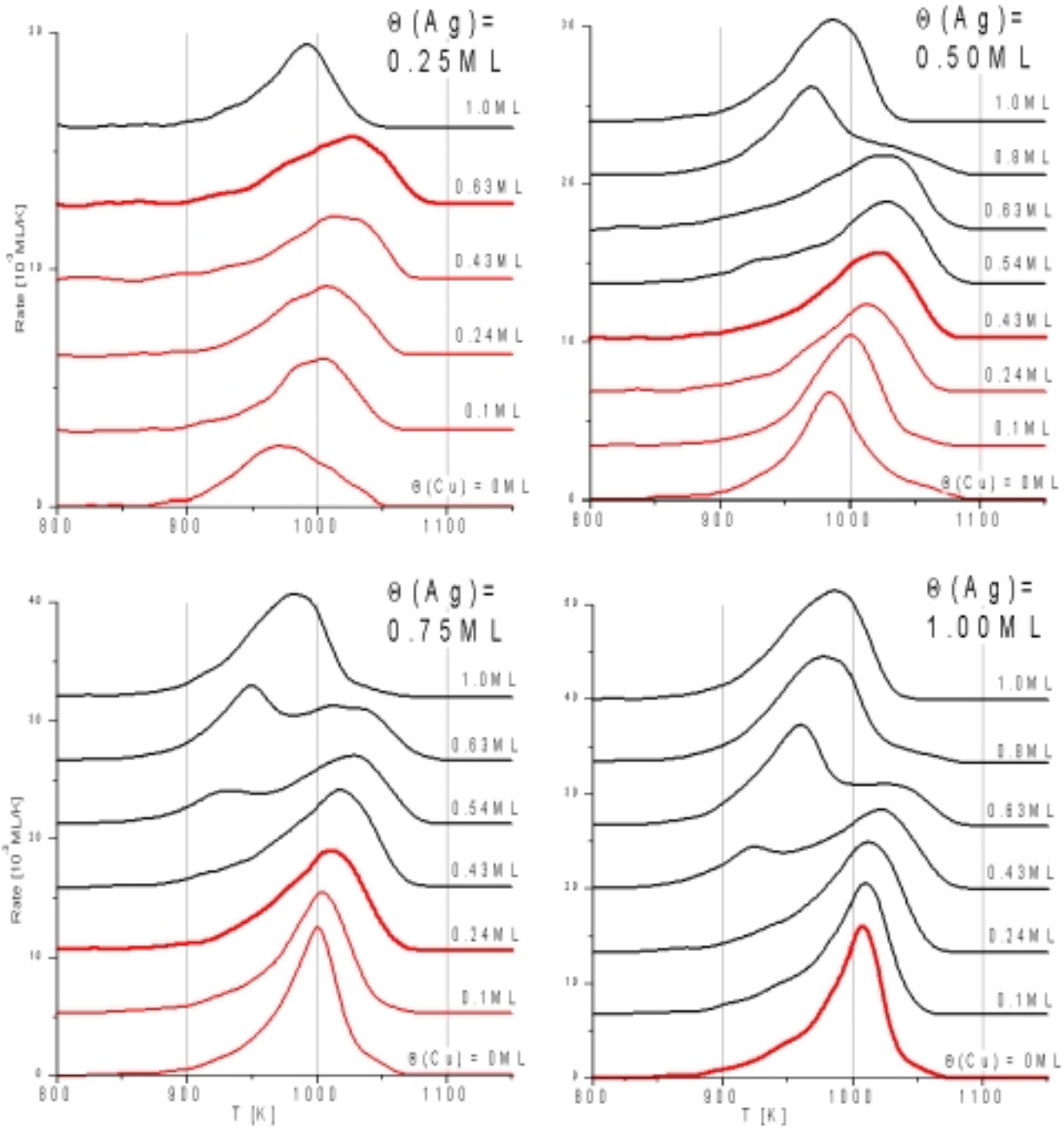
Ag-TPD-spectra Ag/Cu/Re(0001), β=4.1K/s

main parameter: Cu precoverage



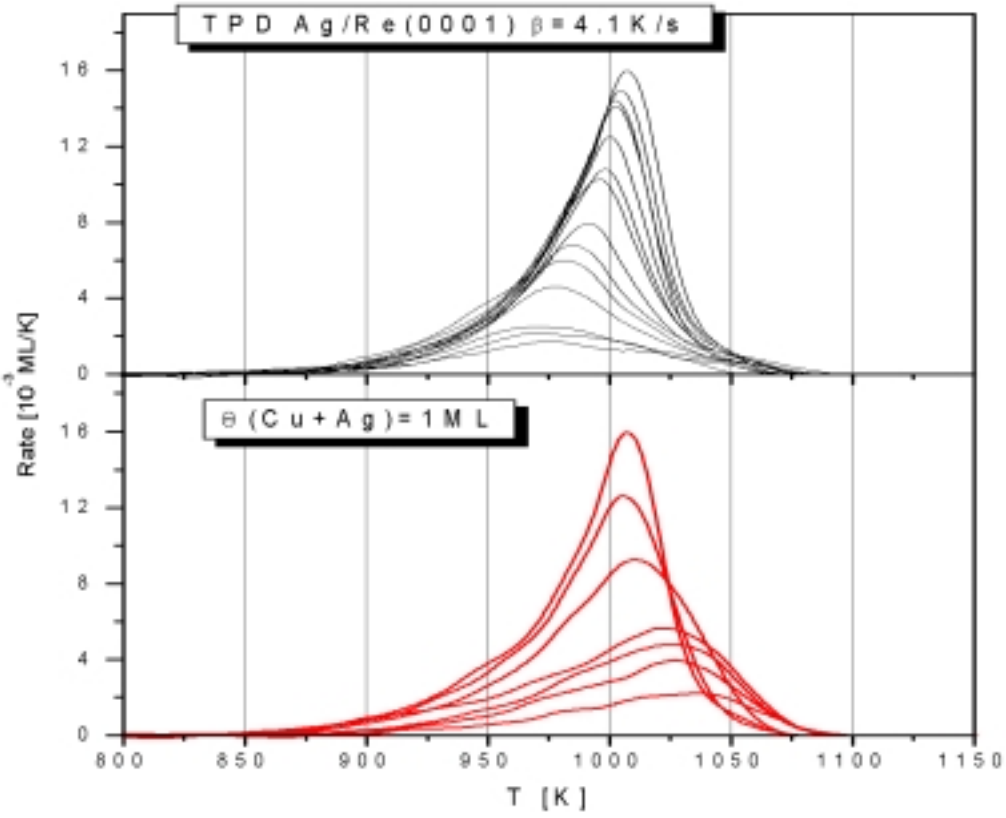
Ag-TPD-spectra Ag/Cu/Re(0001), β=4.1K/s

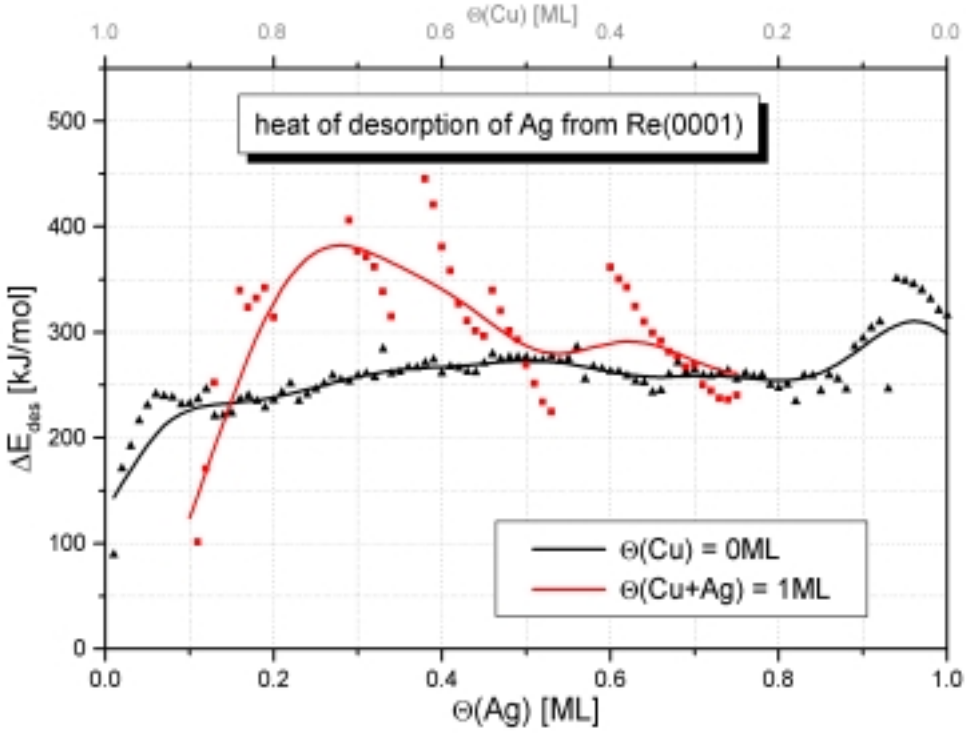
main parameter: Ag coverage



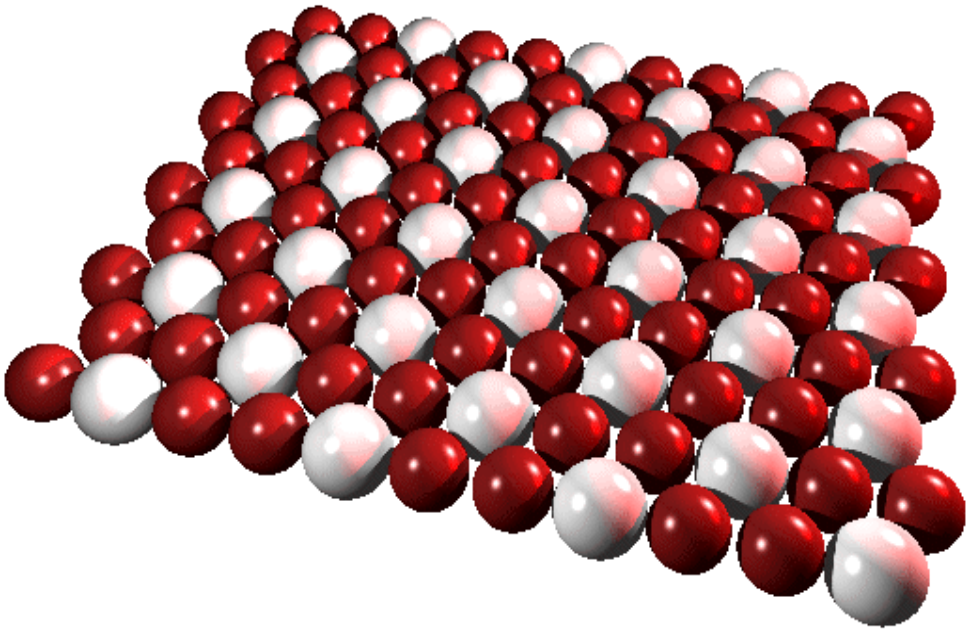
red: one layer copper + silver

submonolayer desorption of Ag from the clean Re(0001) surface and from a Cu matrix

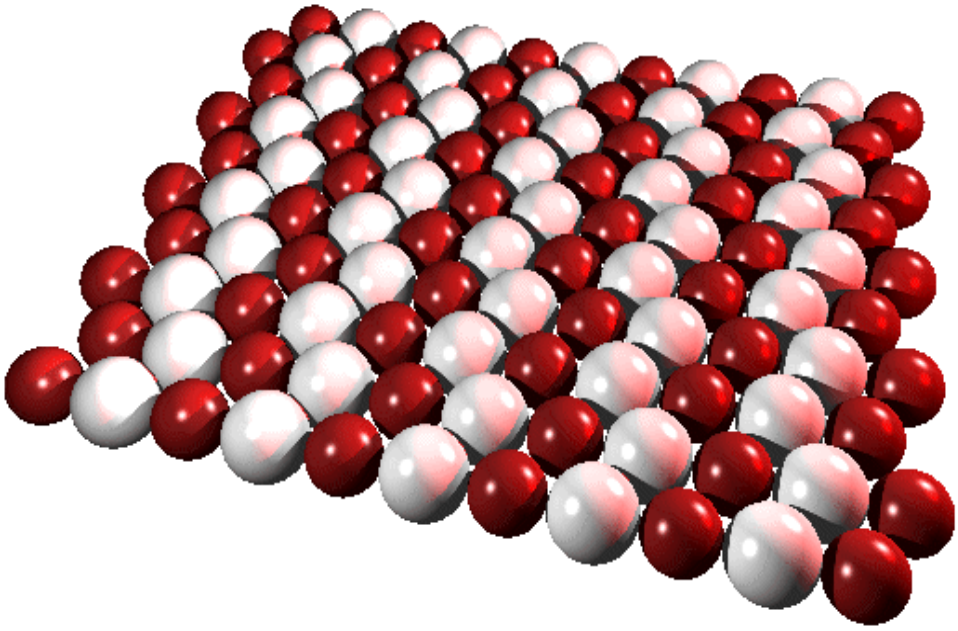




Suggestions for the distribution of silver and copper in the surface alloy

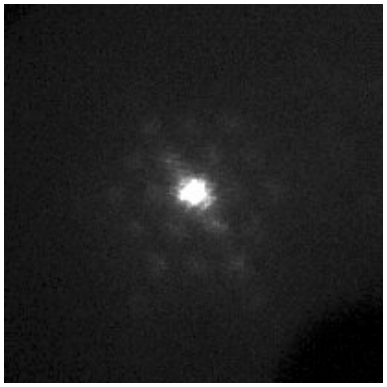


ratio of silver / copper = 1:2



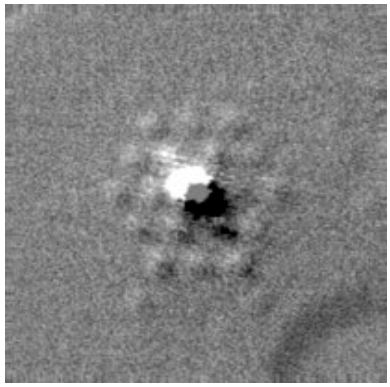
ratio of silver / copper = 1:1

LEED pattern of a 2.2 ML Ag + 2.2 ML Cu - alloy film

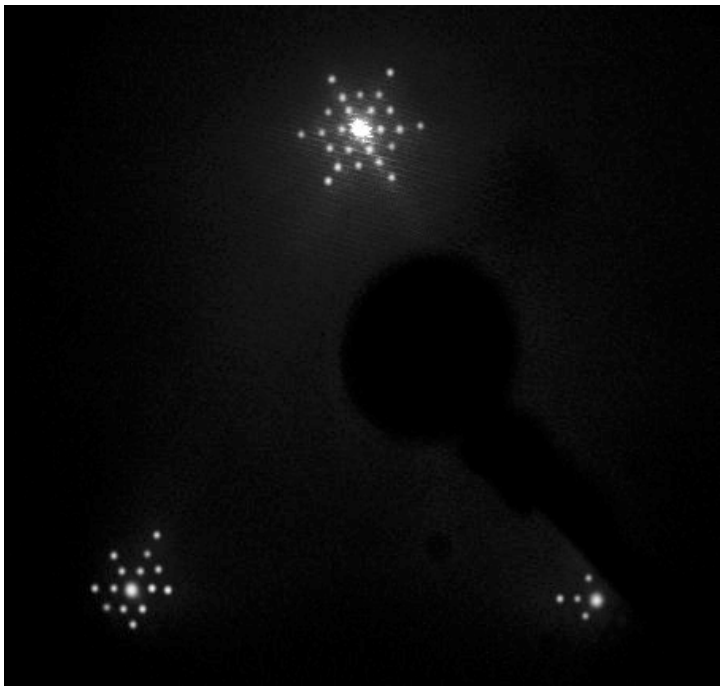


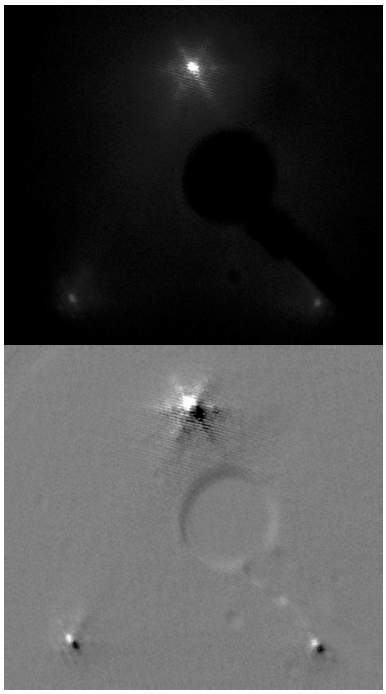
(0,0) beam

17.6 eV



(25 x 25) superstructure





54.7 eV

Summary:

Ag and Cu form a continous series of 2D mixed surface crystals, as a result of the registry with the Re lattice and the two-dimensionality

Films up to 10 ML thickness exhibit a characteristic crystallography

Ag-Cu interactions seem to be stronger then Ag-Ag interactions

Future work:

STM, XPS and CO-TPD measurements

Investigations of other binary systems: Ag-Au/Re and Cu-Au/Re