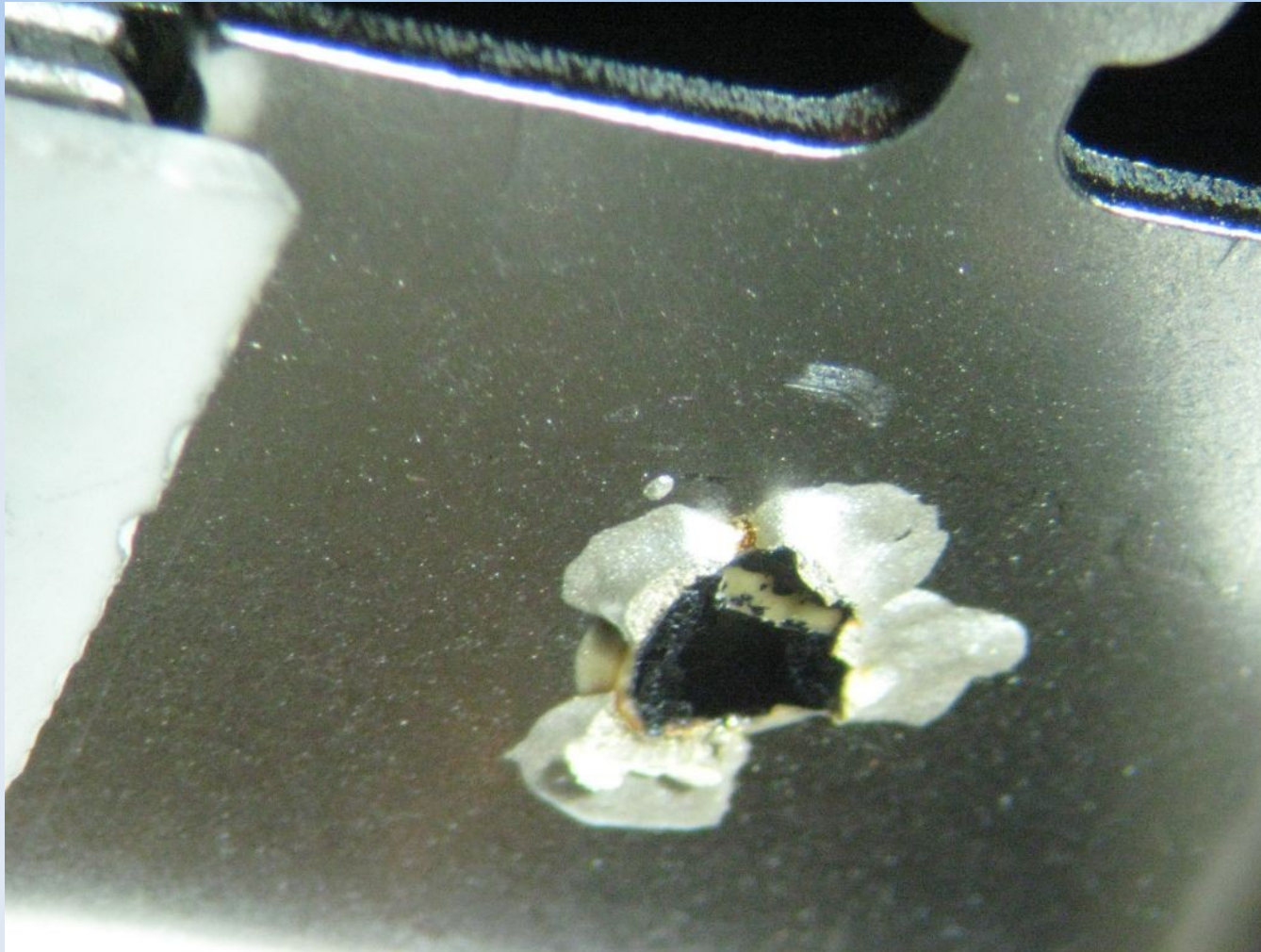
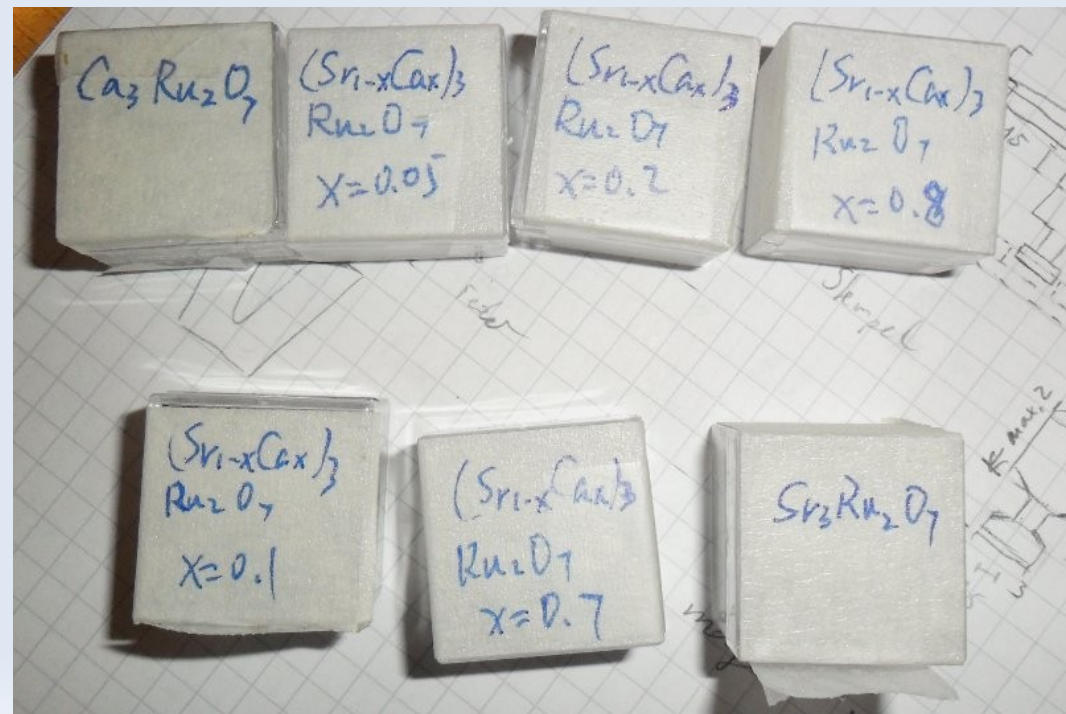


Surface Analysis of $\text{Ca}_3\text{Ru}_2\text{O}_7$



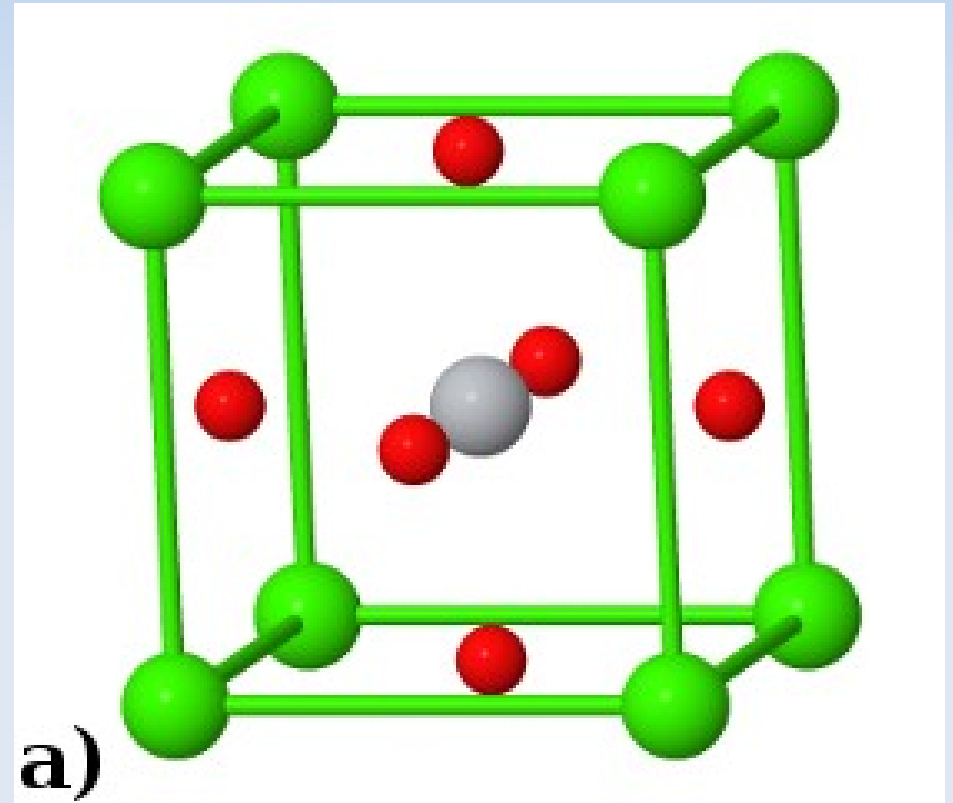
Introduction

- Project work and introduction for the diploma thesis on surface science
- Original aim: surface analysis of the Ruddlesden-Popper perovskites:
 $(\text{Sr}_{1-x}\text{Ca}_x)\text{Ru}_2\text{O}_7$
x ranging from 0 to 1
- Reduced to analysis of $\text{Ca}_3\text{Ru}_2\text{O}_7$



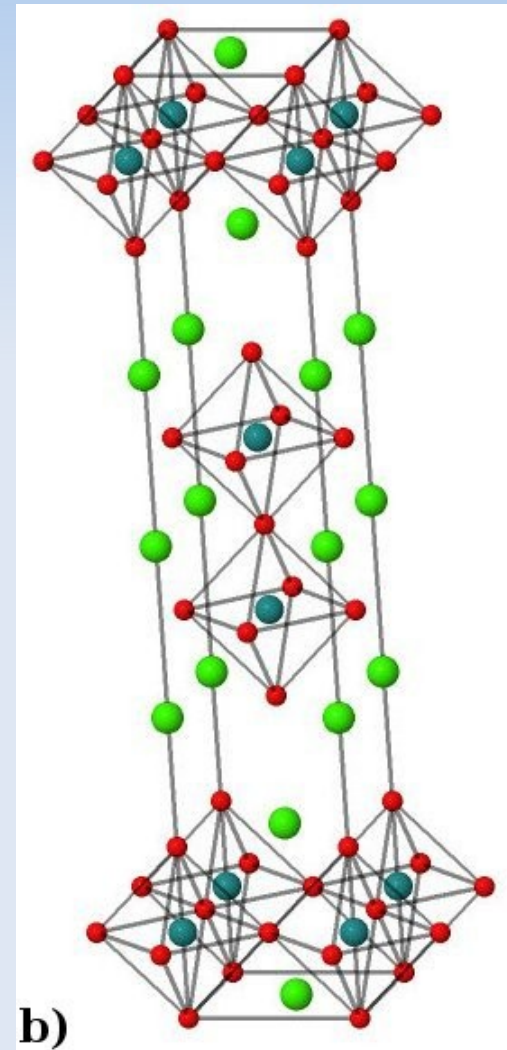
Basic Perovskite Structure

- Perovskite: CaTiO_3
- ABX_3 – Structure
 - A: white, B: green, X: red
- Wide range in physical properties
- Variety of applications



Ruddlesden-Popper Series

- $A_{n-1} A'_2 B_n X_{3n+1}$
 - n: layers of octahedra in the perovskite stack
- Consists of perovskite layers and rock salt type layers
- Our Samples: $A_3B_2X_7$
 - A: green, B: blue, X: red



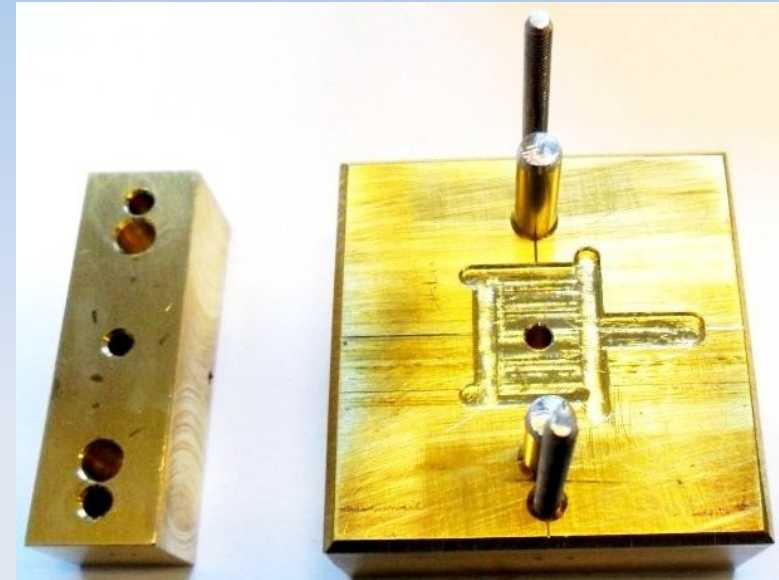
Sample preparation

- Very reaktive surface
- Usual sample preparation methods (sputtering, annealing) don't work
- Cleaving in UHV and scanning immediatley afterwards
 - Glueing the sample to the sample holder
 - Glueing a stub on top of the sample
 - Knocking off the stub



Glueing

- Glues
 - Epo-Tek H77
 - Epo-Tek H21D silver glue
- Difficulties:
 - Position on the sample holder
 - Catching the stubs
 - Conductivity
 - Hardness of the glue

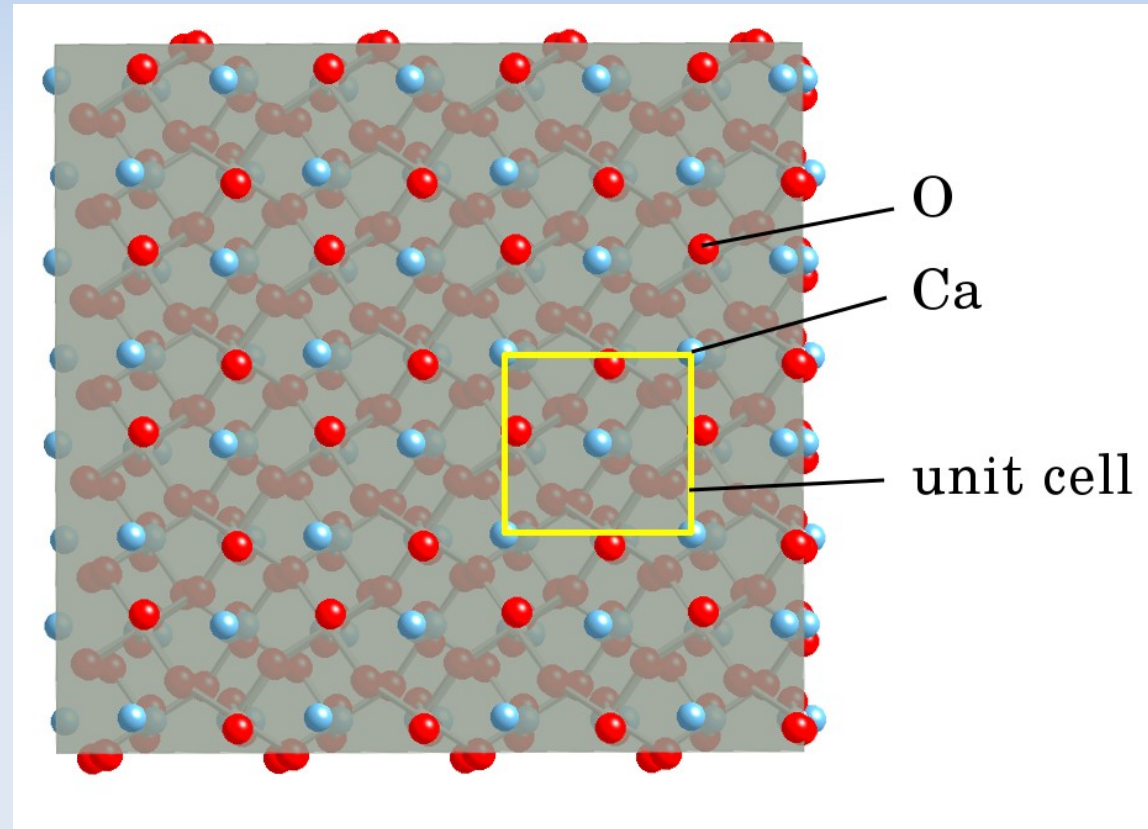


Glueing Approaches

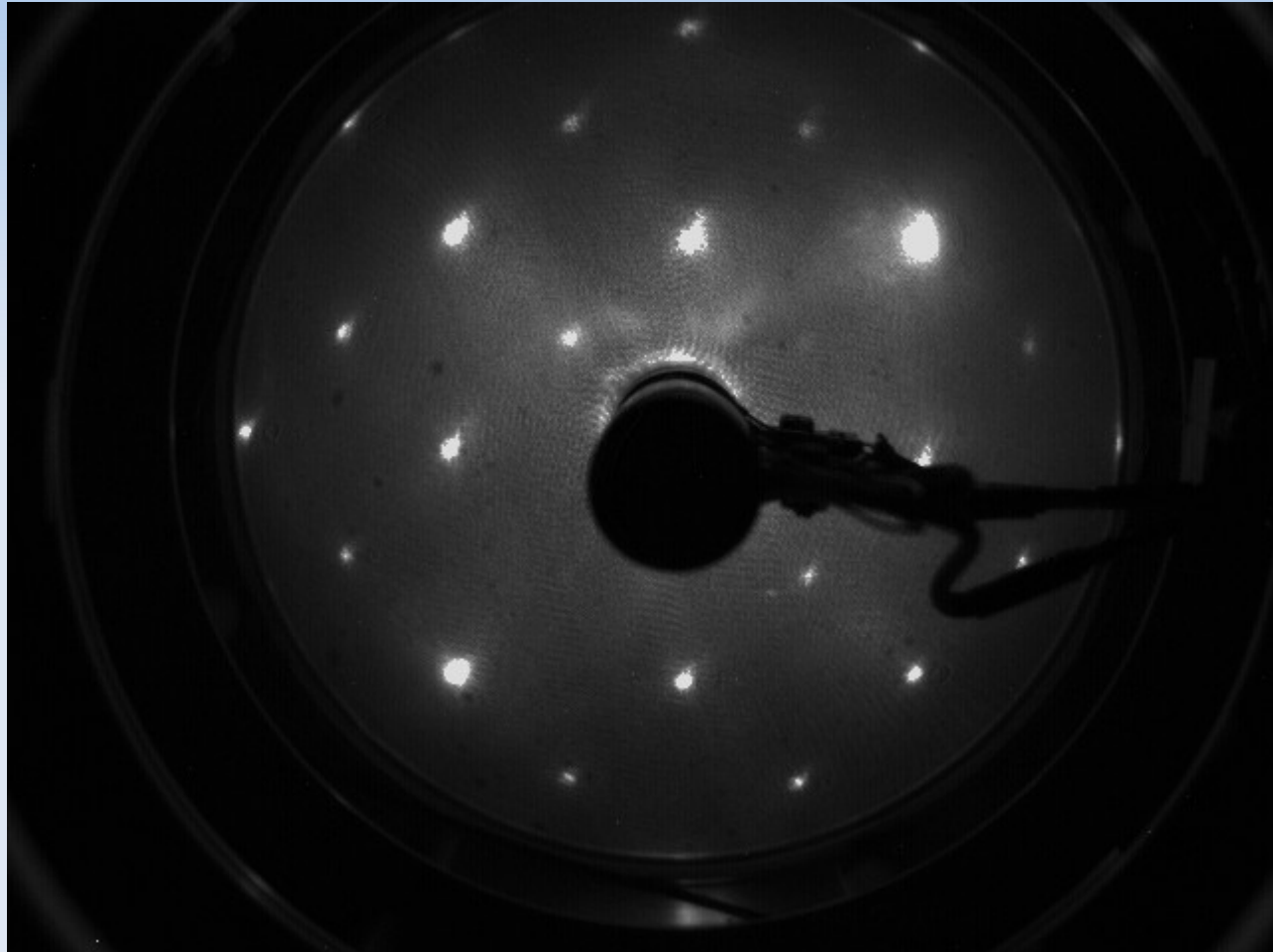
- H77, silver glue contacts on the sides
 - Time consuming (3 curing steps)
 - Conductivity no reliable
- H77, roughen sample holder with center punch
 - Conductivity no reliable
- Only silver glue
 - Hardness not guaranteed
- Silver glue between sample and sampleholder
H77 between sample and stub

$\text{Ca}_3\text{Ru}_2\text{O}_7$ lattice

- Reconstructed $\text{Ca}_3\text{Ru}_2\text{O}_7$ lattice
(Data: Yoshida et al., PRB, 72(5):054412)
- Virtually cleaved with CrystalMaker
- Square lattice



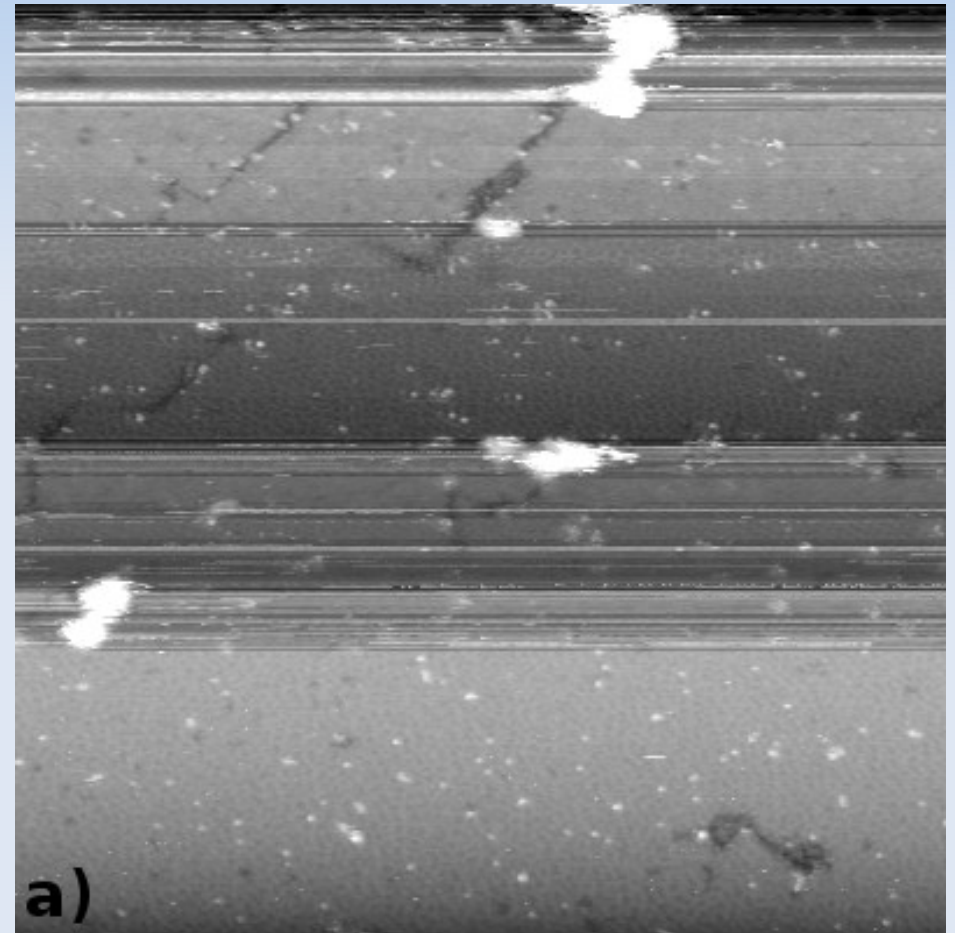
LEED of $\text{Ca}_3\text{Ru}_2\text{O}_7$



- LEED confirmed the square lattice

STM of $\text{Ca}_3\text{Ru}_2\text{O}_7$

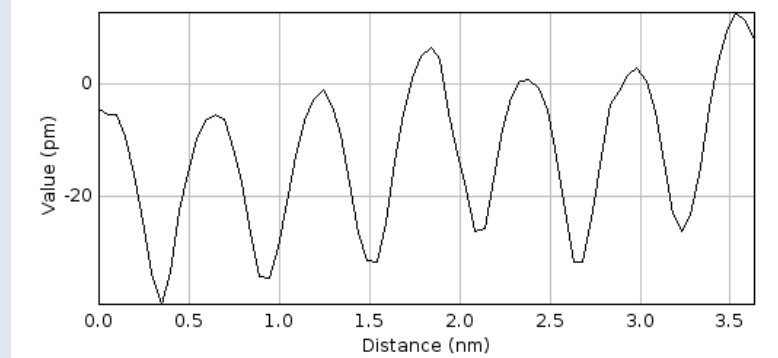
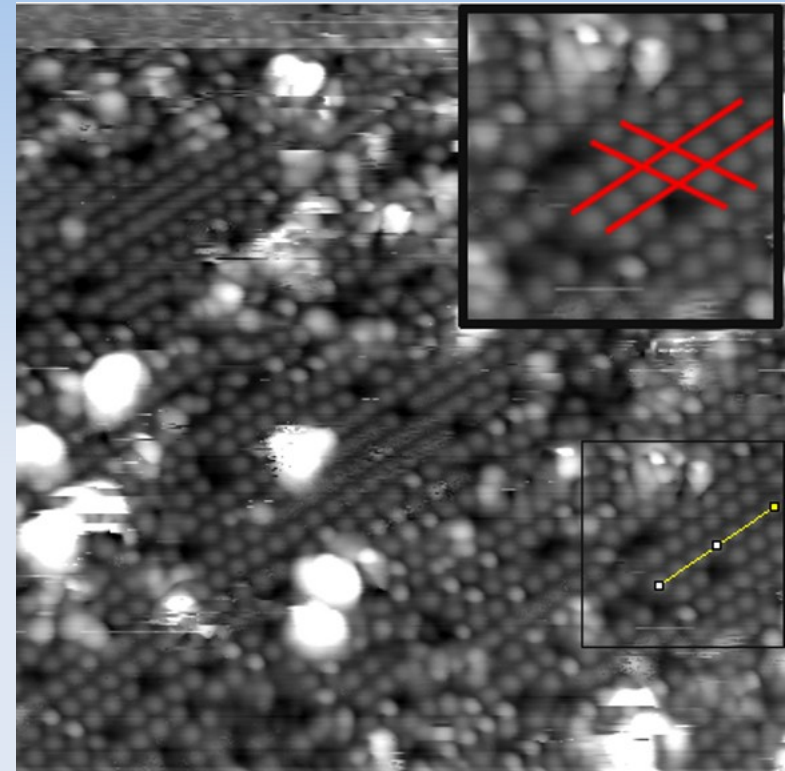
- Wide flat areas
- Cracks
- Bright features
 - Seem to increase over time
- Very difficult to obtain good STM images
 - Unstable tip
 - Fast surface contamination



100x100 nm², -1.2 V, 0.1 nA

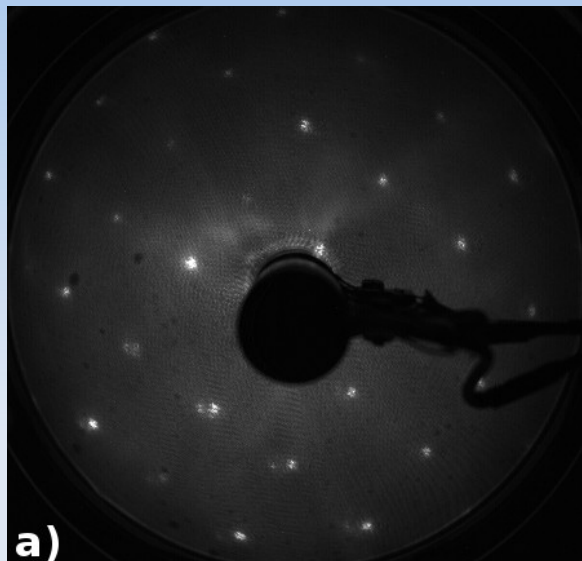
Atomic Resolution

- Large bright features
- Voids
- Lattice of 0.58 nm in one direction, 0.66 nm and an angle of 120° between
 - No square lattice
 - Adsorbate



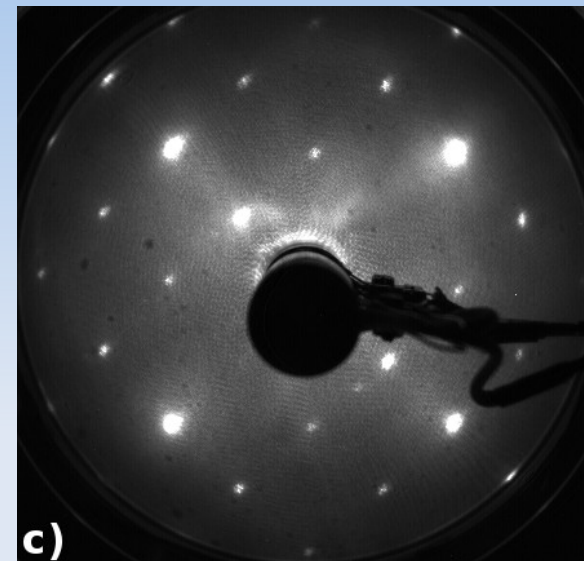
20x20 nm², -1.2 V, 0.35 nA

Dosing of CO₂ and O₂ - LEED

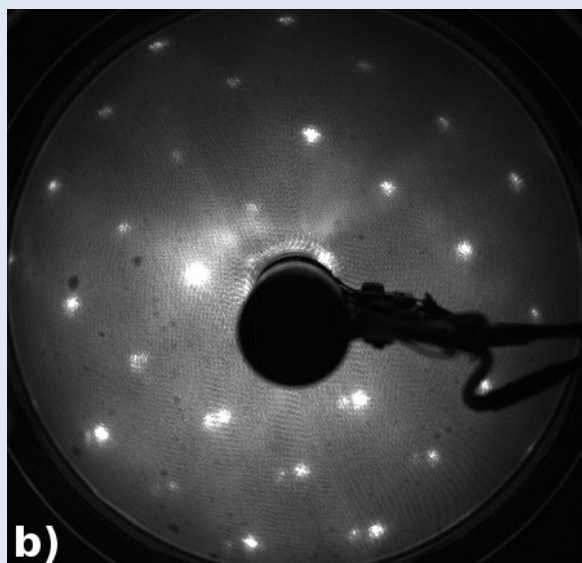


a)

100 eV 90 eV
undosed



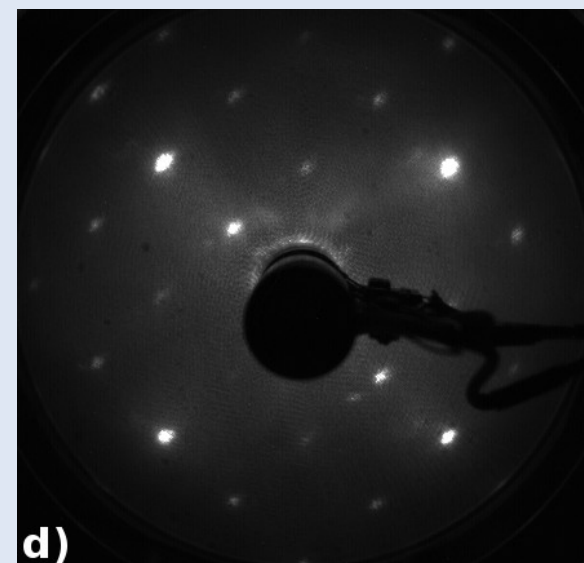
c)



b)

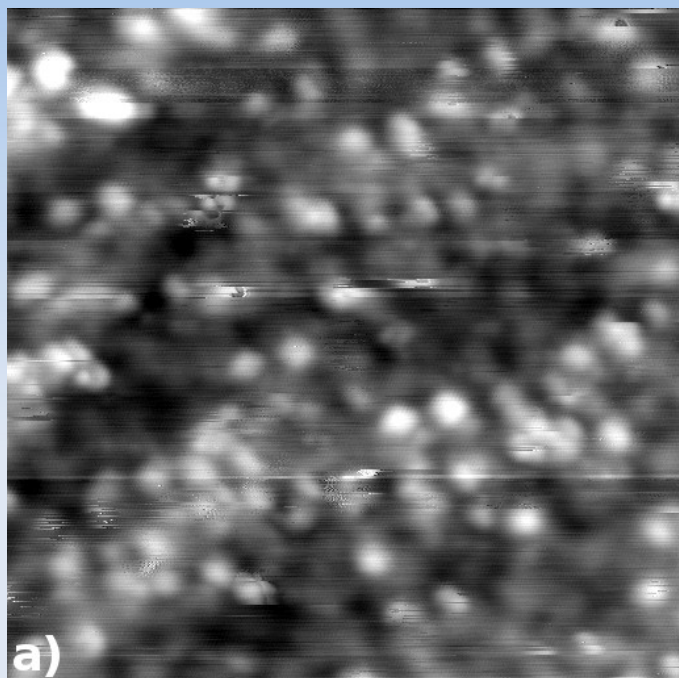
100 eV 90 eV
CO₂ O₂
dosed

- No difference

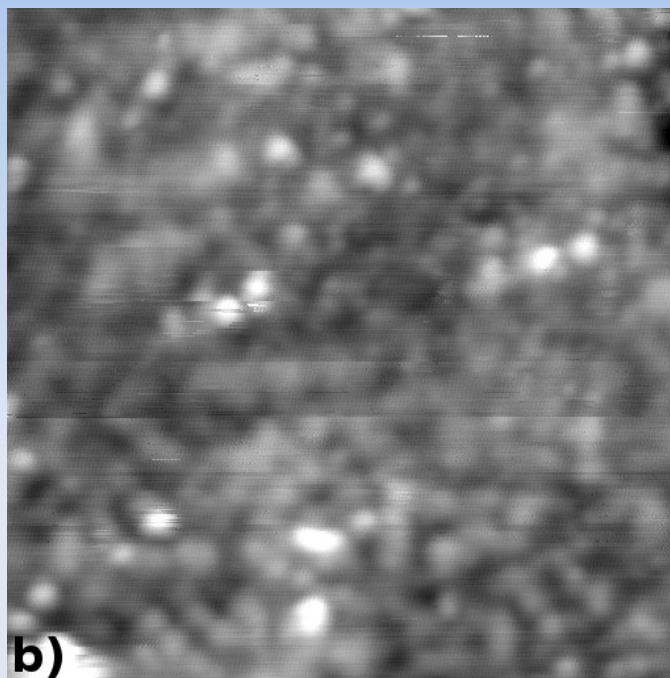


d)

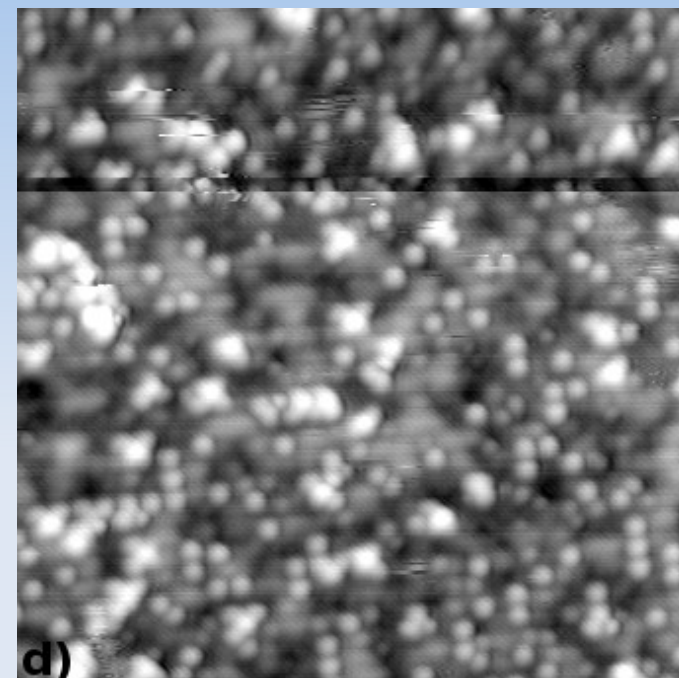
Dosing of CO₂ and O₂ - STM



Undosed



O₂



CO₂

- Difficult to compare
- No obvious effect

Thank you