

# BM32

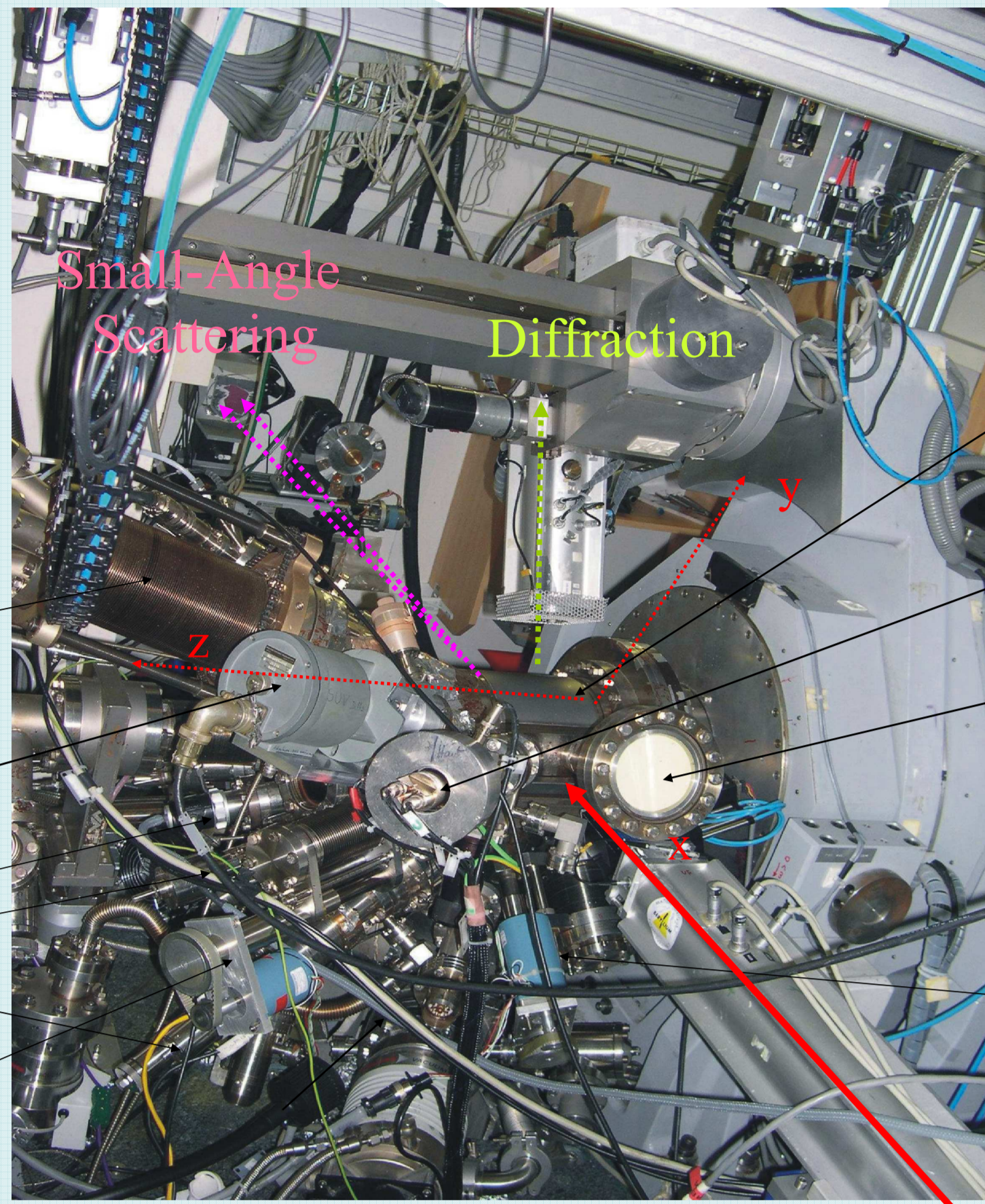
# In-situ Investigation of Growth - State of the Art and Outlook on BM32

T. U. Schüllli<sup>1</sup>, G. Renaud<sup>1</sup>, M.-I. Richard<sup>1</sup>, O. Geaymond<sup>2</sup>  
<sup>1</sup>CEA/DSM/INAC/SP2M/NRS, 17 avenue des martyrs, F-38043 Grenoble  
<sup>2</sup>Institu Néel, CNRS Grenoble, 25 avenue des Martyrs



UHV-Surface Diffractometer:  $P \sim 10^{-10}$  mbar

Sample Temperature: 200-2500 K



Auger e<sup>-</sup> Spectrometer

Pyrometer

Effusion Cells

UHV Beam-Stop

Be-Window

Ion-gun

RHEED Screen

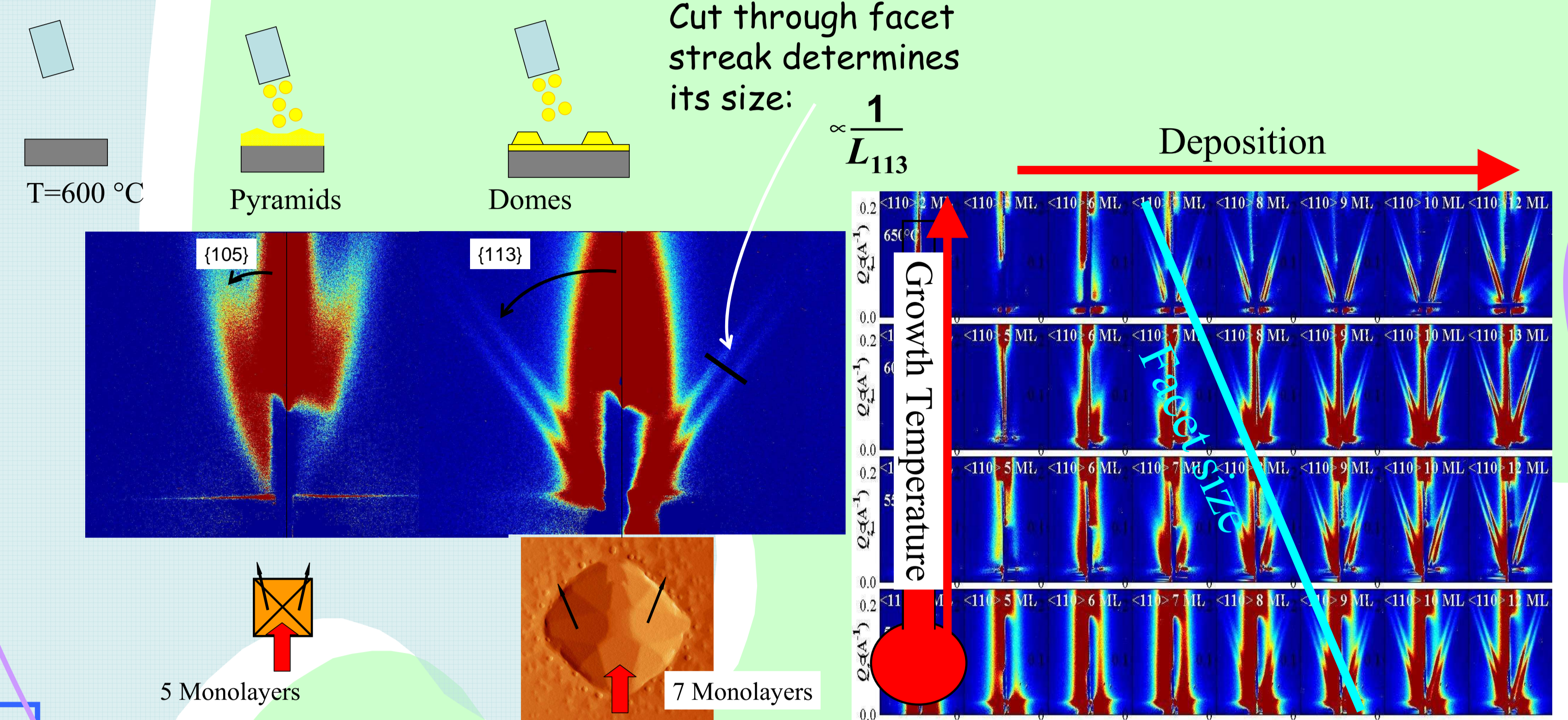
UHV Aperture

X-ray Beam

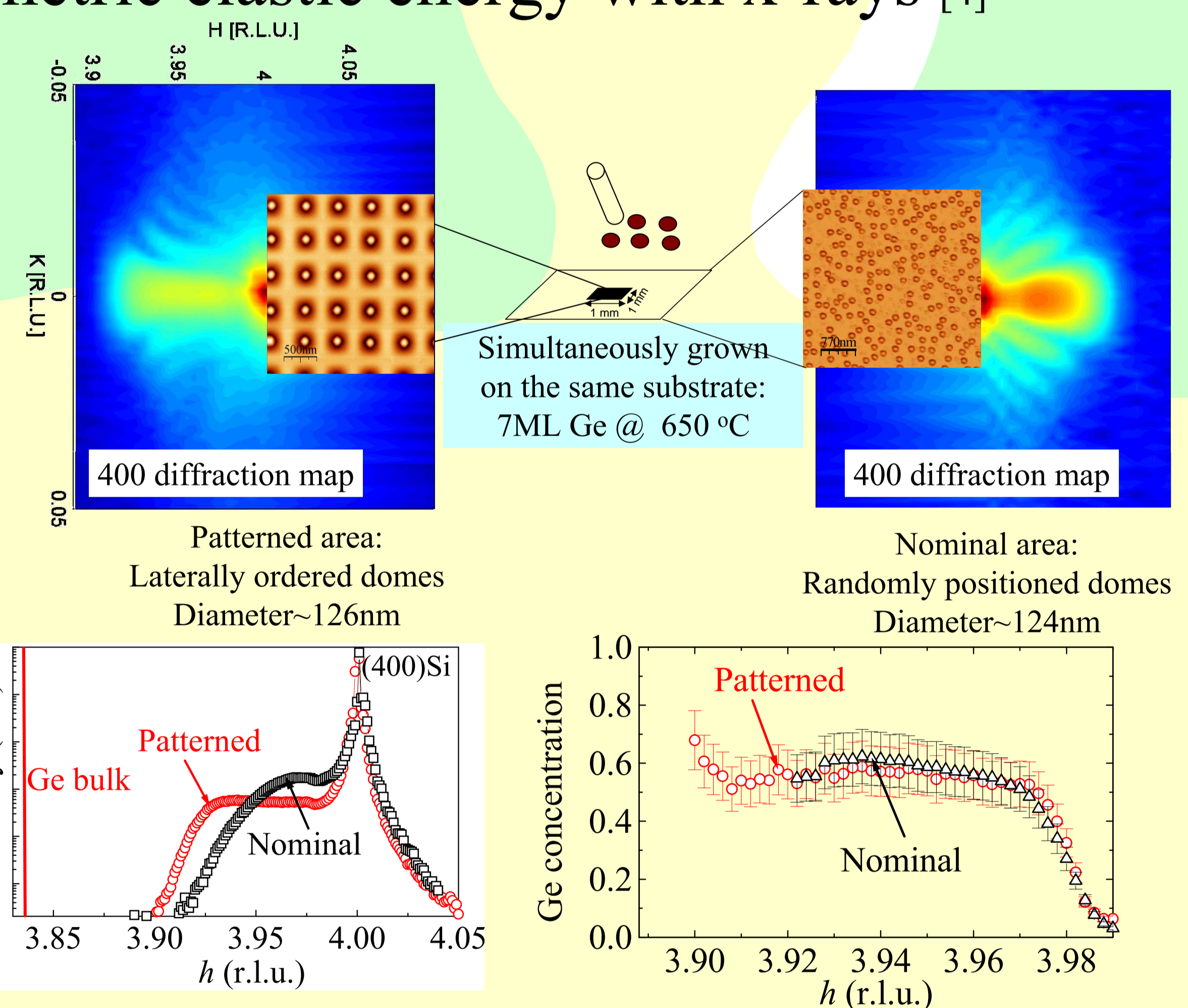
The instrument SUV on BM32 consists in a highly versatile UHV growth chamber on a 6-circle diffractometer in Z-axis geometry. Grazing Incidence Small Angle X-ray Scattering (GISAXS) is employed to monitor the growth of nano-particles *in situ* and at high temperatures. The same experimental setup allows for Grazing Incidence Diffraction (GID) and Crystal Truncation Rod Analysis (CTRA). The combination of surface crystallography and GISAXS supplies a complete information about **shape, size, strain and epitaxial relationship** of the nano-particles. As anomalous diffraction is possible at BM32 between 6 and 30 keV, an analysis of the compositional evolution is also possible. Basically all materials compatible with UHV conditions can be grown. Extensive research is done on **metal/oxide** interfaces, semiconductor **quantum-dots** and **organic semiconductors**. A gas distribution apparatus will open the way to perform Chemical Vapour Deposition (CVD)-like growth modes

## Nucleation, growth and faceting

### Ge-deposition : of Ge on Si(001) [1,2]

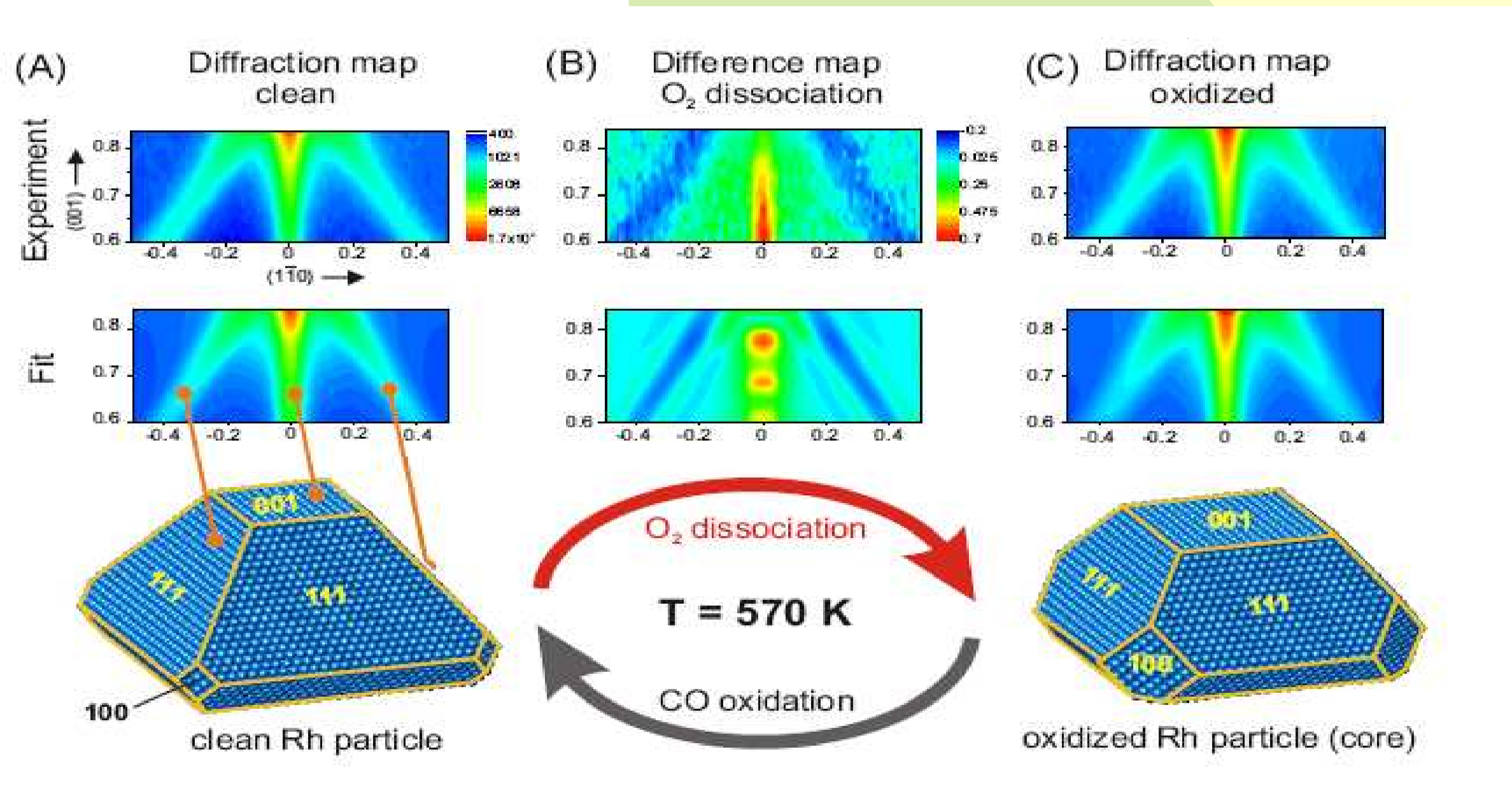
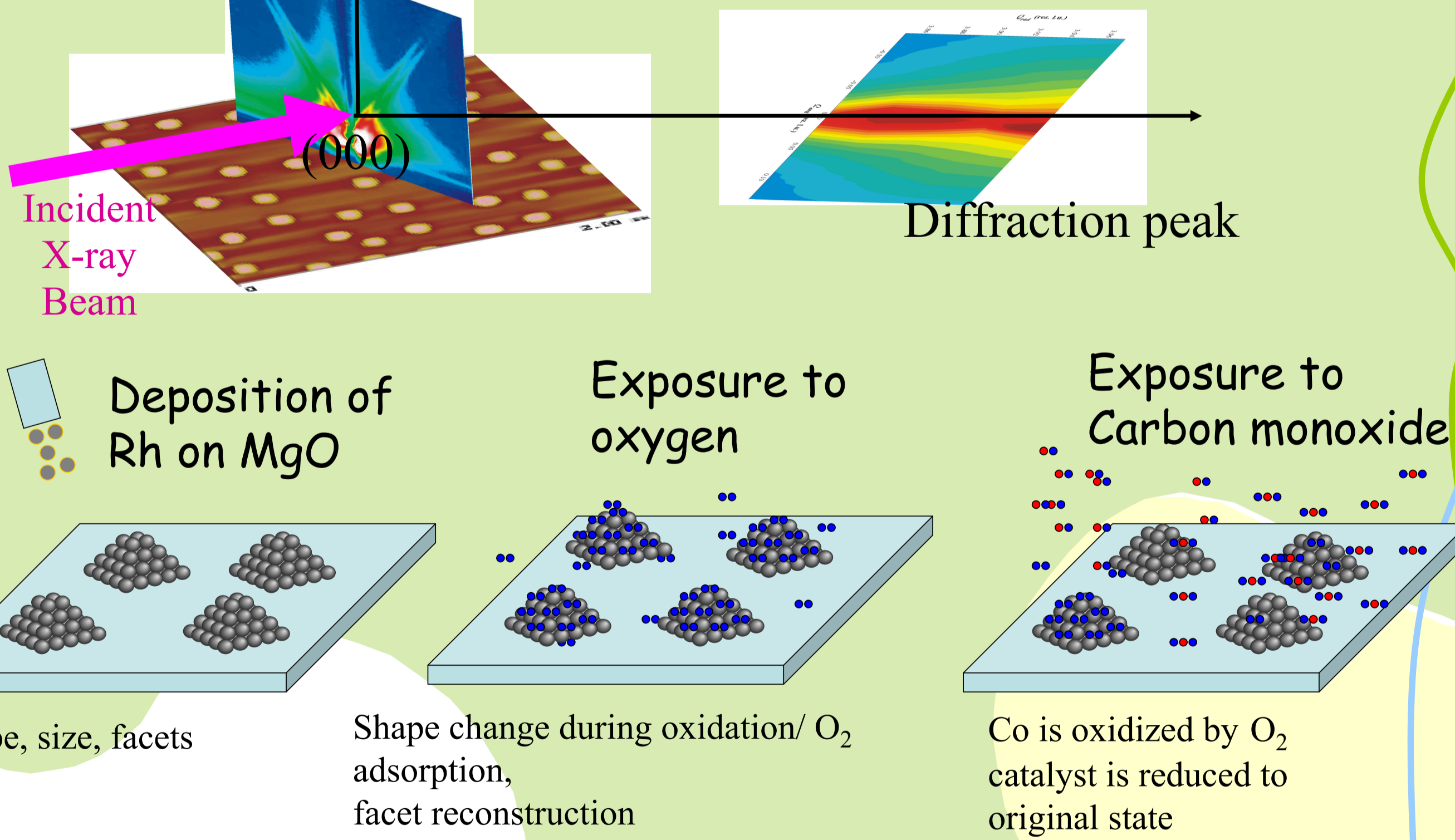


## Growth on novel substrates: determination of volumetric elastic energy with x-rays [4]

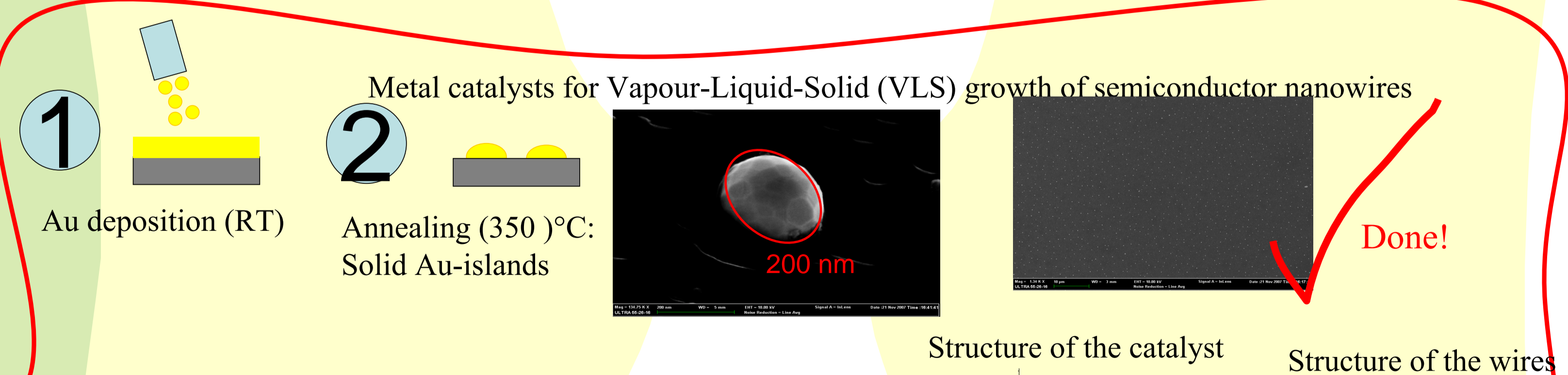


## Nanoparticles as active catalysts [3]

Combined study GISAXS+GID:



This study draws a picture of cyclic changes undergone by a catalyst during the reaction: changes of shape and the atomistic structure of the interface become visible in combining small angle and diffraction methods.

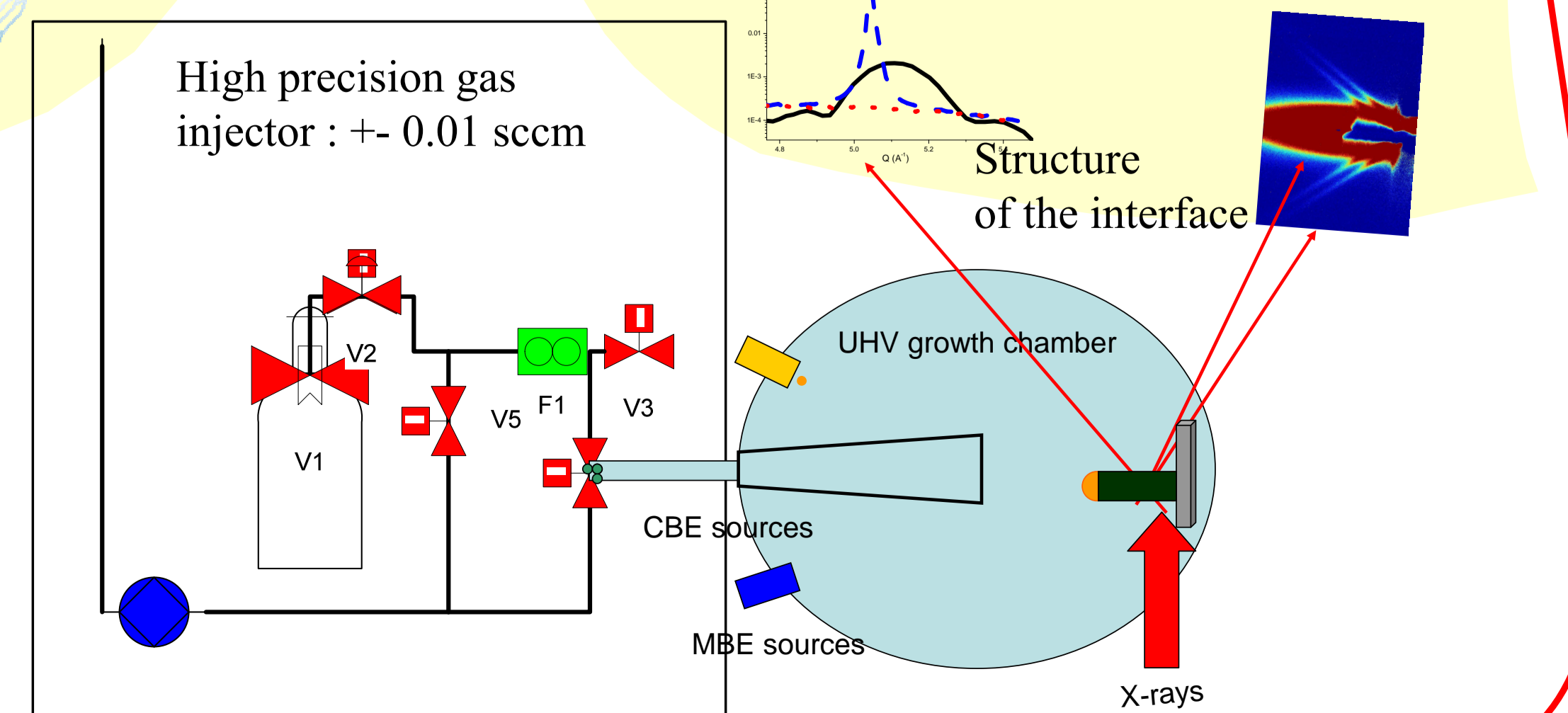


nanoSCIENCES FONDATION

3 Exposure to SiH<sub>4</sub> flux (injection system to be build)

Chemical Beam Epitaxy: Gas injection in the molecular regime

At T~ 500°C: Metal catalysts crack the gas and nucleation of wires sets in



[1] T. U. Schüllli, M.-I. Richard, G. Renaud, V. Favre-Nicolin, E. Wintersberger, G. Bauer, Appl. Phys. Lett. **89**, 143114 (2006).  
[2] M.-I. Richard, T. U. Schüllli, G. Renaud, E. Wintersberger, G. Bauer, V. Holy, submitted to Phys. Rev. B (2008).  
[3] P. Nolte, A. Stierle, N.-Y. Jin-Phillipp, N. Kasper, T. U. Schüllli, H. Dosch, Science **321**, 1654 (2008).  
[4] T.U. Schüllli, G. Vastola, M.-I. Richard et al. Phys. Rev. Lett. in press (on-line January 2009).