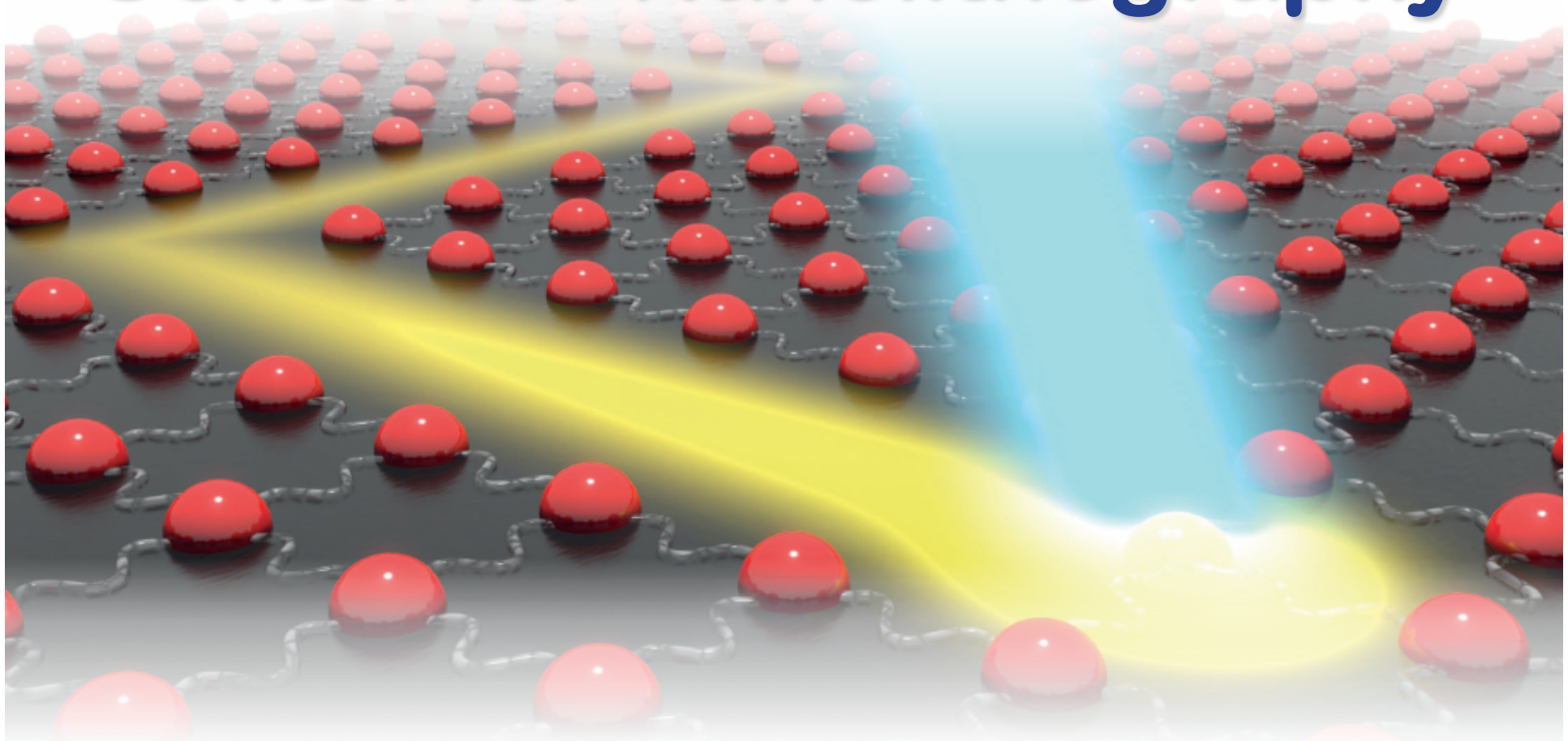


The Advanced Research Center for Nanolithography



The Advanced Research Center for Nanolithography

MISSION

The research of ARCNL focuses on the fundamental physics that is involved in or related to current and future technologies that are or will be employed in the context of lithography and nanolithography, primarily for the semiconductor industry.

PARTNERS

Foundation for Fundamental Research on Matter (FOM/NWO), University of Amsterdam, VU University Amsterdam, ASML

LOCATION

Amsterdam Science Park

ARC: birth of a new concept

Initiative:

ASML
2013

Partners:

ASML
FOM/NWO
UvA, VU

Extra contributions:

city A'dam
prov. NH



Form:

ARC

Size:

~100 fte

Style:

managed
as FOM-
institute

EUV lithography

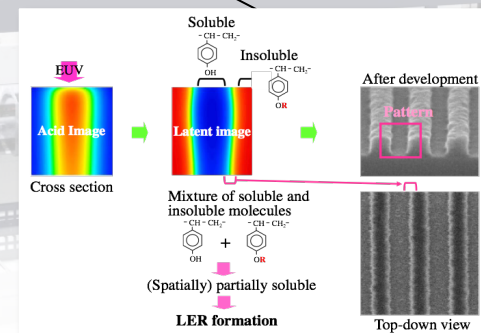
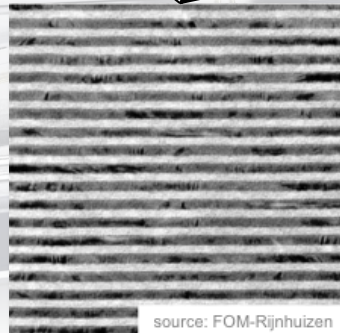
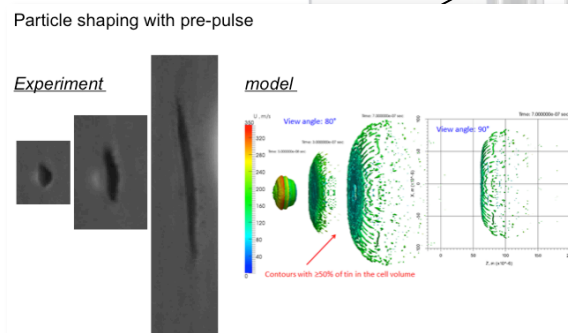
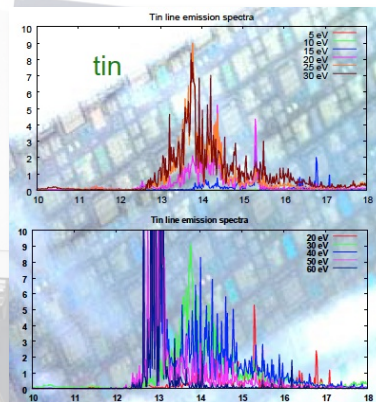
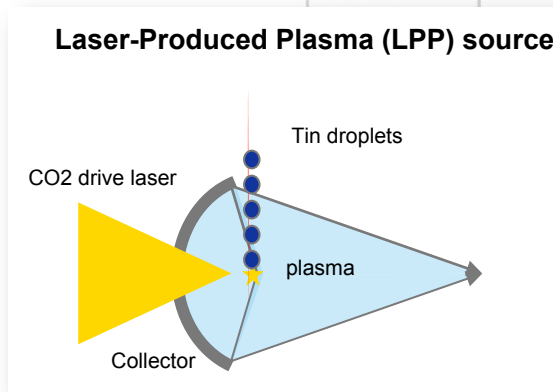
extreme ultraviolet: *13.5 nm*



Source: ASML, Veldhoven, 2013

EUV lithography

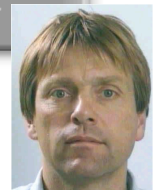
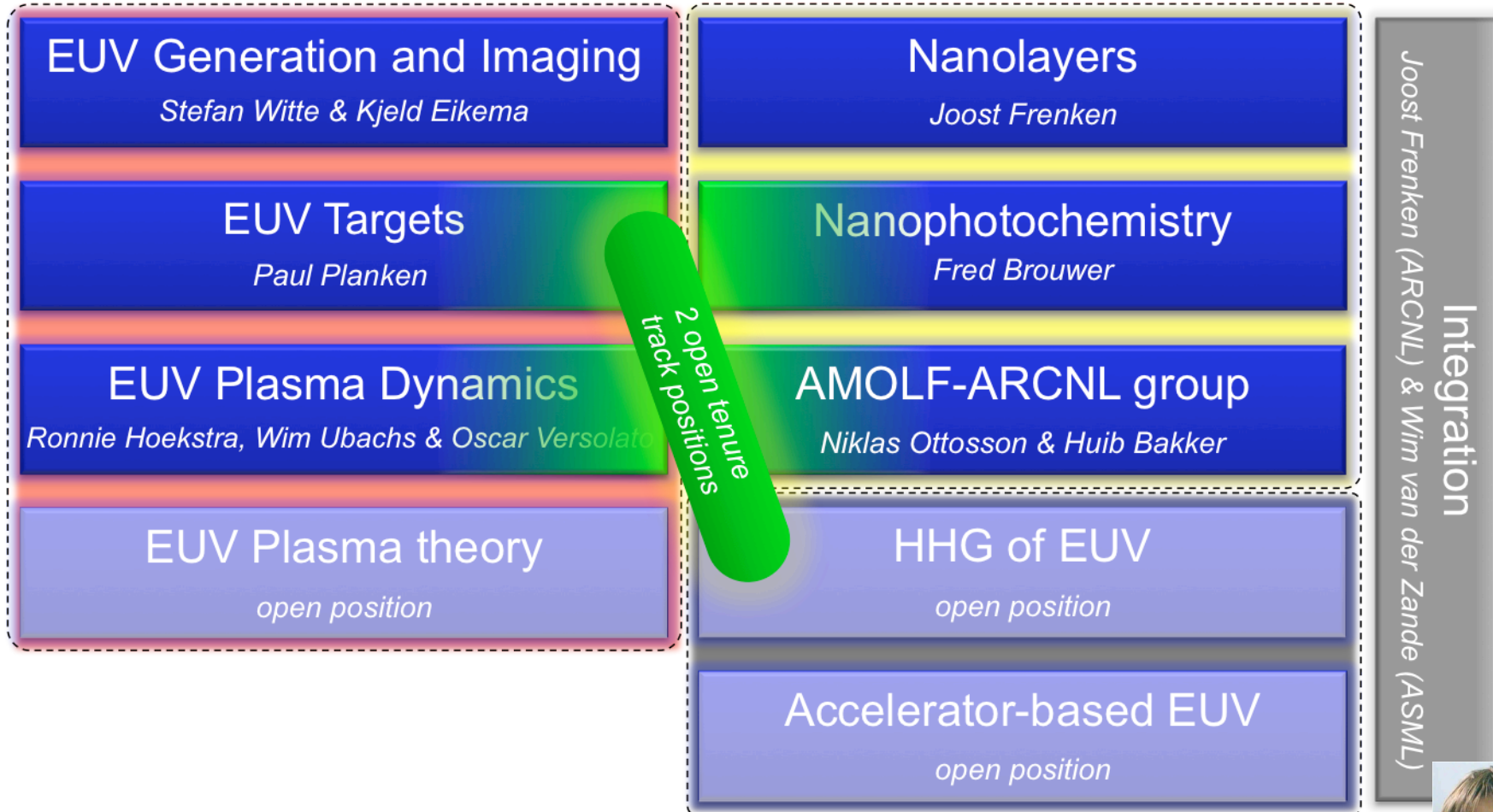
extreme ultraviolet: 13.5 nm



ASML, Veldhoven, 2013



Scientific program



Temporary labs and offices



- Temporary laboratory
400 m² lab space
In use since mid October 2014



- Temporary offices
(capacity 96 people)
In use since end of December 2014
- Long-term housing (Matrix-VII) in preparation (complete in 2018)

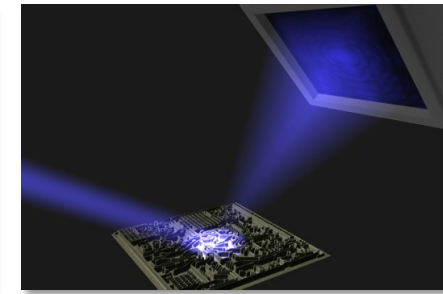
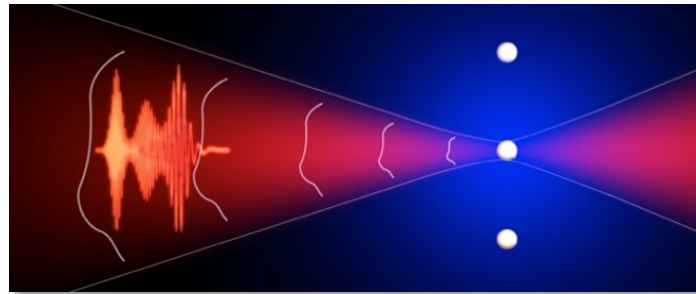
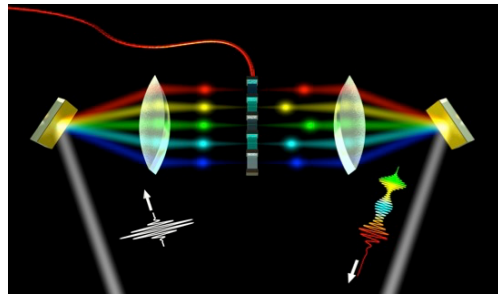
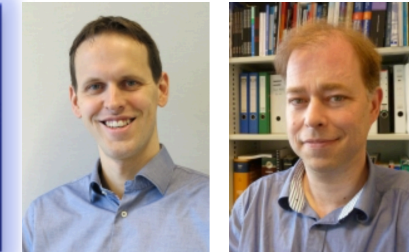


Scientific program



EUV Generation and Imaging

Stefan Witte & Kjeld Eikema



- Adaptive wavefront control IR pulse: spatial shape (plasma production) & temporal shape (EUV emission from dynamic plasma)
- High-harmonic generation (HHG) source(s) of EUV
- Contribute to Plasma Dynamics Group (IR pump – EUV probe spectroscopy)
- Coherent EUV-based lenseless imaging (e.g. metrology)

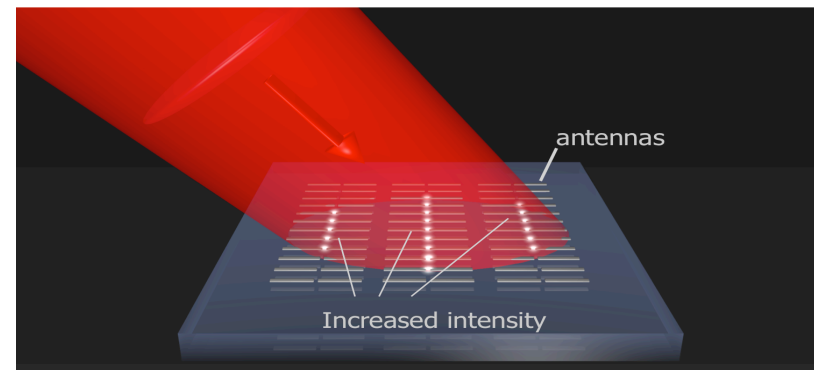
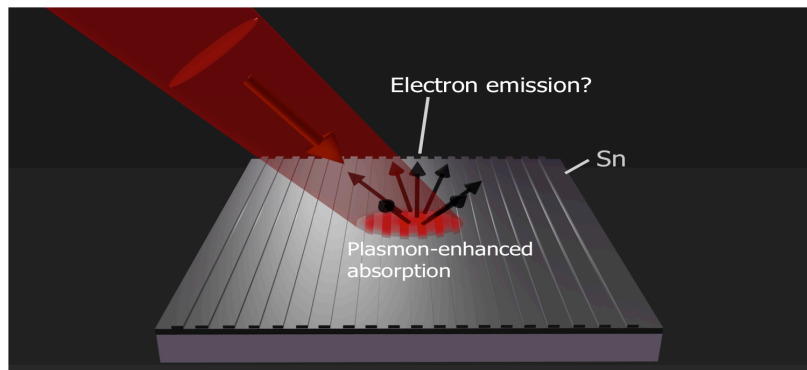


Scientific program



EUV Targets

Paul Planken



- IR on nanostructured Sn surfaces: in-coupling e.g. via surface plasmon + “lattice”
- Nano-antenna structures
- Time-resolved measurements
- Fluid dynamics: interplay of IR pulse – droplet shape – plasma formation
(link with work by Hanneke Gelderblom c.s.: part of FOM-IPP Detlef Lohse (UT) – ASML)

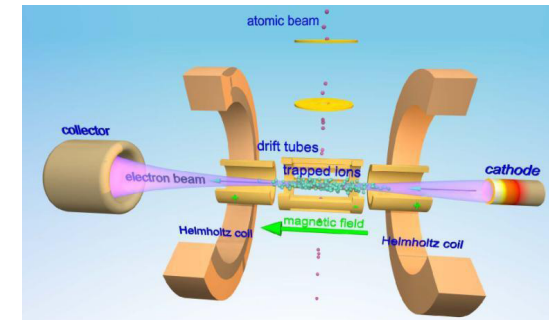
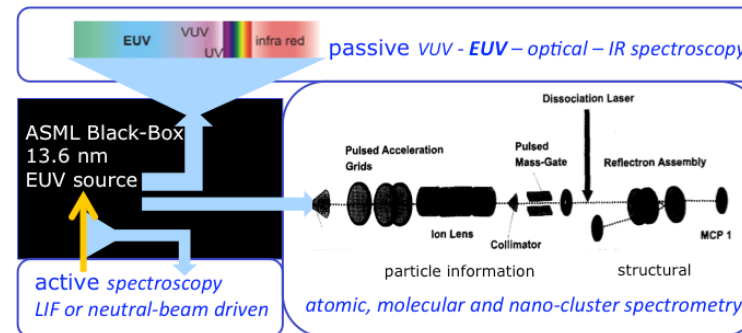
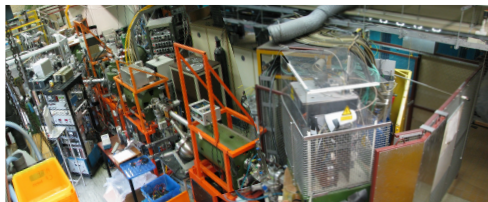


Scientific program



EUV Plasma Dynamics

Ronnie Hoekstra, Wim Ubachs & Oscar Versolato



- Analysis of species, abundancies, energies in plasma using optical spectroscopy and mass spectroscopy
highly charged ions, radicals, molecules, clusters
- Support data (cross sections, reference spectra) on highly charged ions + highly excited (hollow) atoms + interaction with surfaces (ZERNIKELEIF and CRYRING)
- Electron Beam Ion Trap

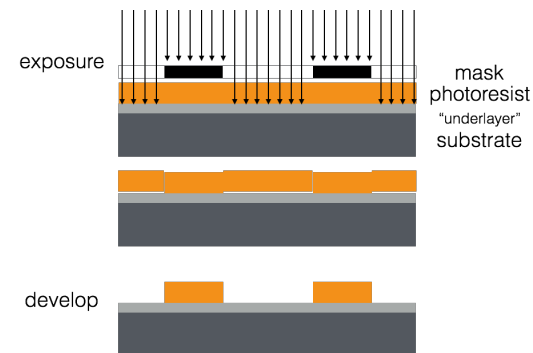
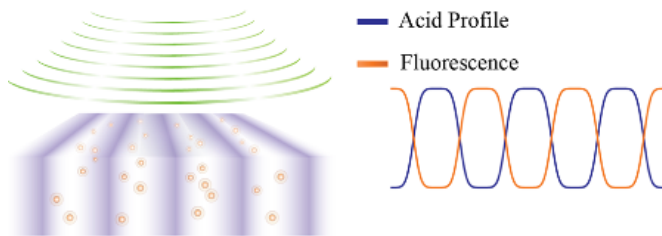


Scientific program



Nanophotochemistry

Fred Brouwer



- EUV interference lithography (SLS, ARCNL)
- Look inside photoresist: fluorescent probes
- New resist concepts:
molecular glasses, cleavable polymers, polymer brushes, inorganic materials
- EUV absorption in 'underlayer'



Scientific program

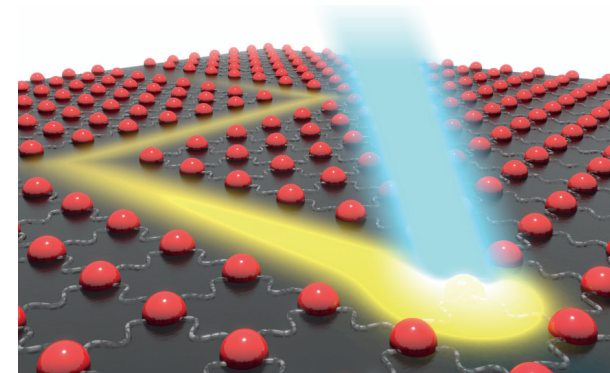


AMOLF-ARCNL group

Niklas Ottosson & Huib Bakker



- EUV Photoelectron spectroscopy
e.g. EUV-exposed surfaces, photoresist
- Further ARCNL-AMOLF projects



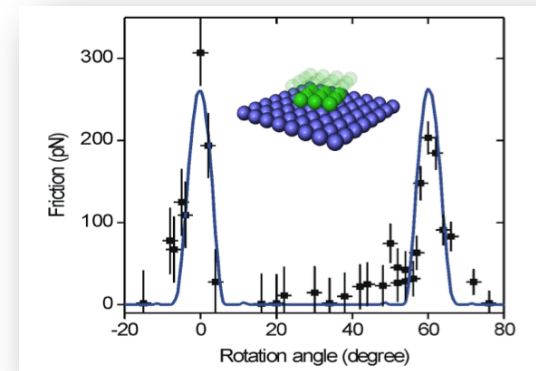
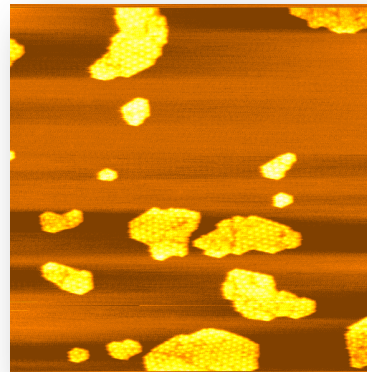
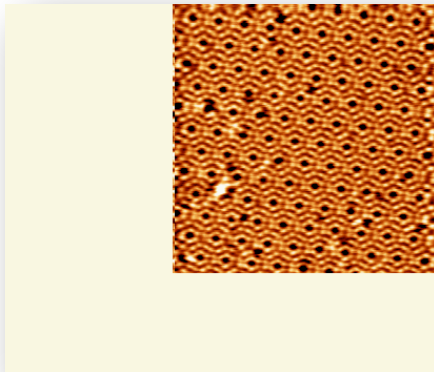


Scientific program



Nanolayers

Joost Frenken



- Live STM: atomic-scale formation of interfaces (multilayer mirrors for 13.5 and 6.5 nm) link with FOM-Focus Group Fred Bijkerk (UT)
- Live STM: atomic-scale formation of graphene and look-alikes (e.g. coatings)
- Friction: atomic-scale origin and novel 'tricks': *superlubricity*, *thermolubricity* (handle on friction and contact forces)

ARCNL prequel: EUV-transparent materials

Growth of graphene (and look-alikes)

Rh(111) surface
exposed to C_2H_4

T = 975 K

$P = 3 \times 10^{-9} \rightarrow 1 \times 10^{-8}$ mbar

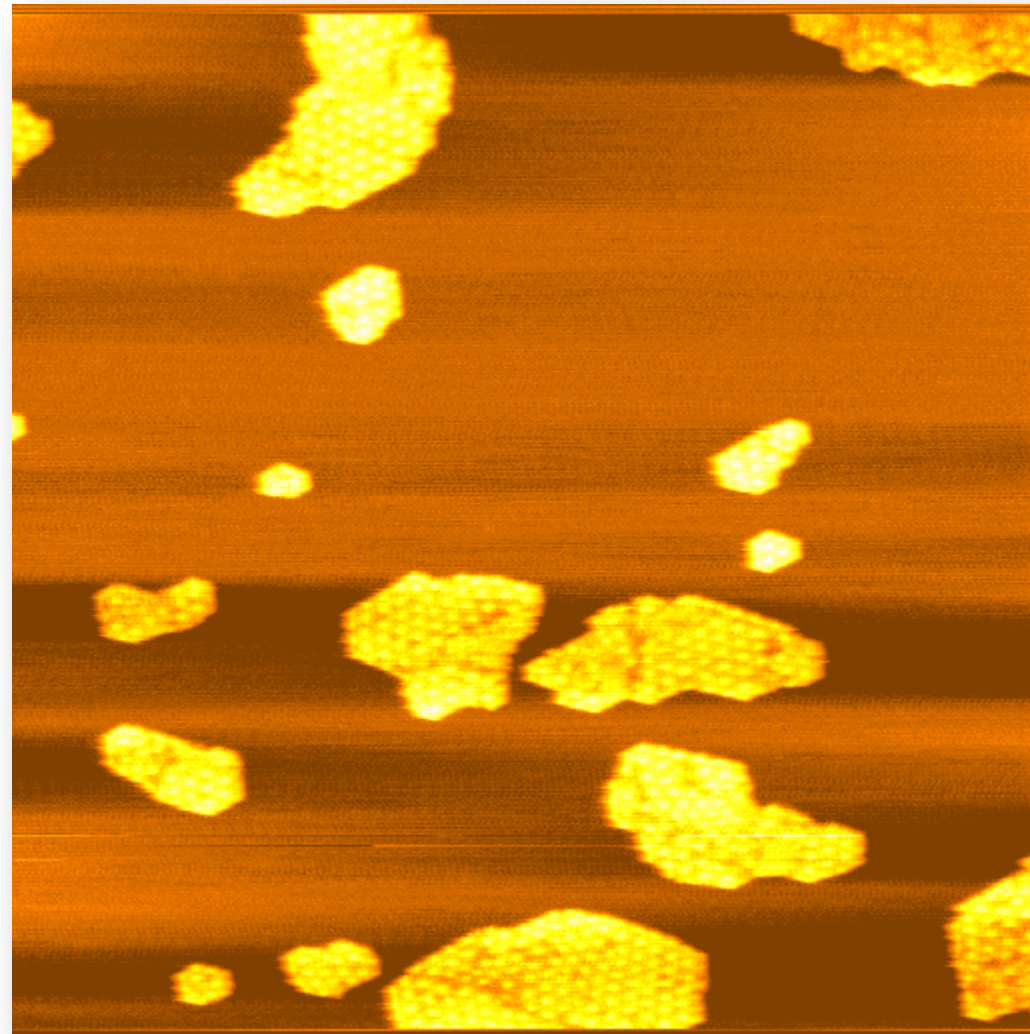
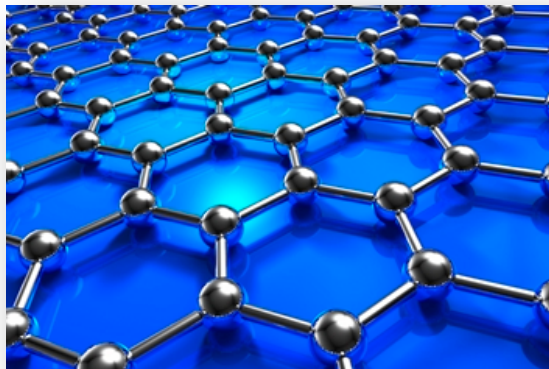
G. Dong et al.,

ACS Nano **7**, 7028 (2013)

New J. Phys. **14**, 053033 (2012)

[*h*-BN on Rh(111):

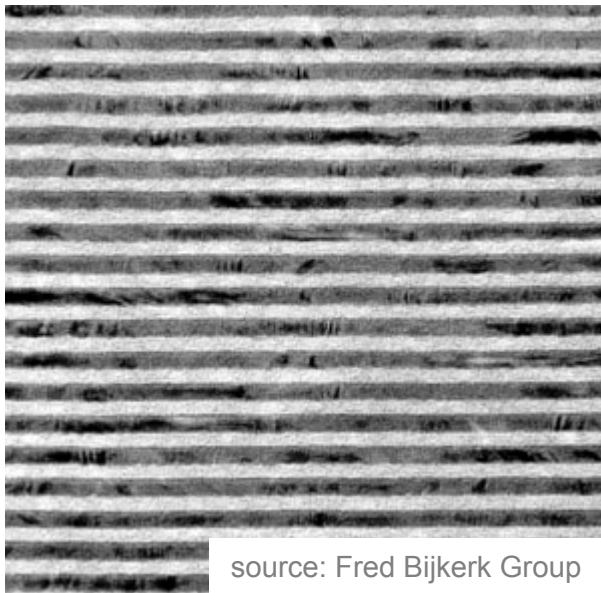
PRL **104**, 096102 (2010)]



← 170 nm →

ARCNL prequel: EUV-optics

Mirror for $\lambda = 13.5$ nm
Bilayer thickness:
6.25 nm (normal incidence)

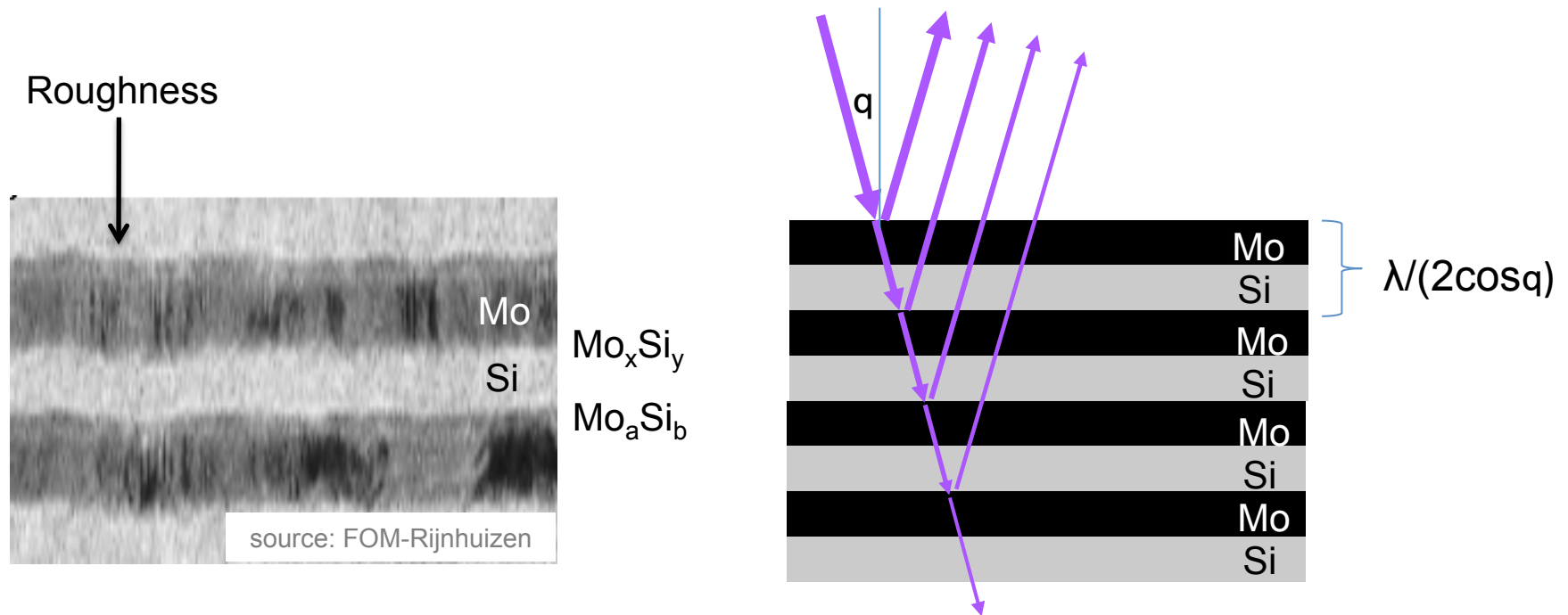


grown by E-beam evaporation or
sputter deposition



CARL ZEISS SMT

ARCNL prequel: EUV-optics

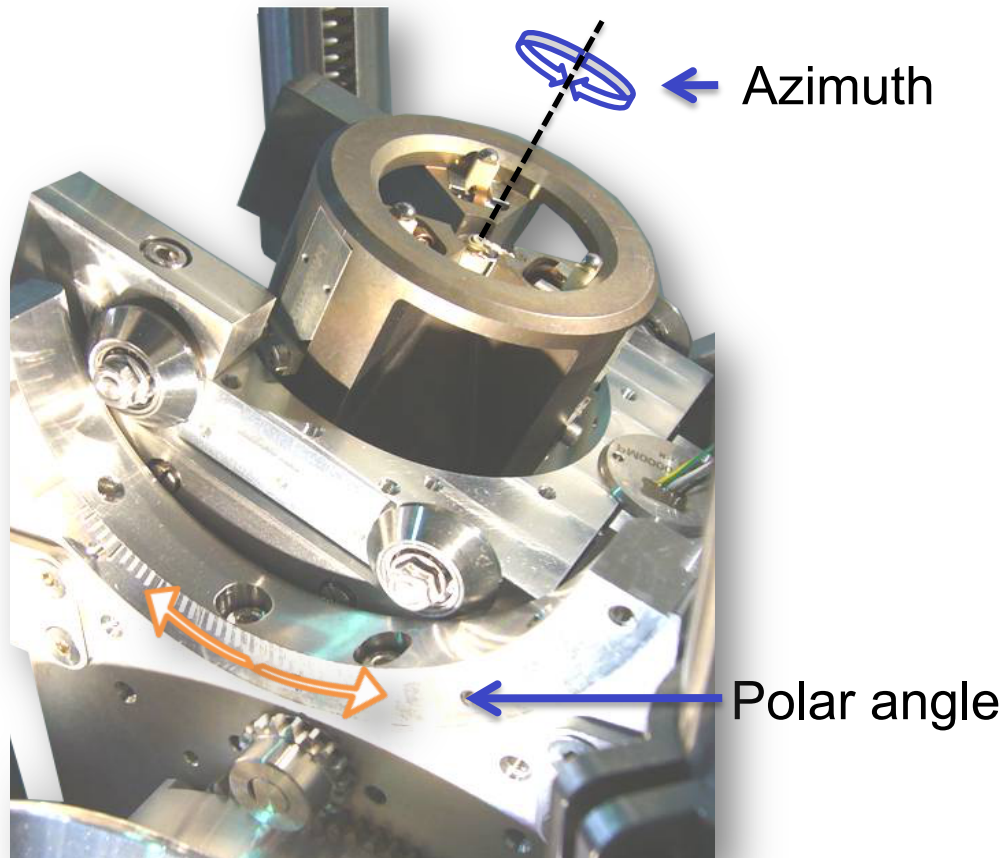


Why so rough!? Roughness reduces reflectivity

Depo-STM: in-situ growth / ion erosion

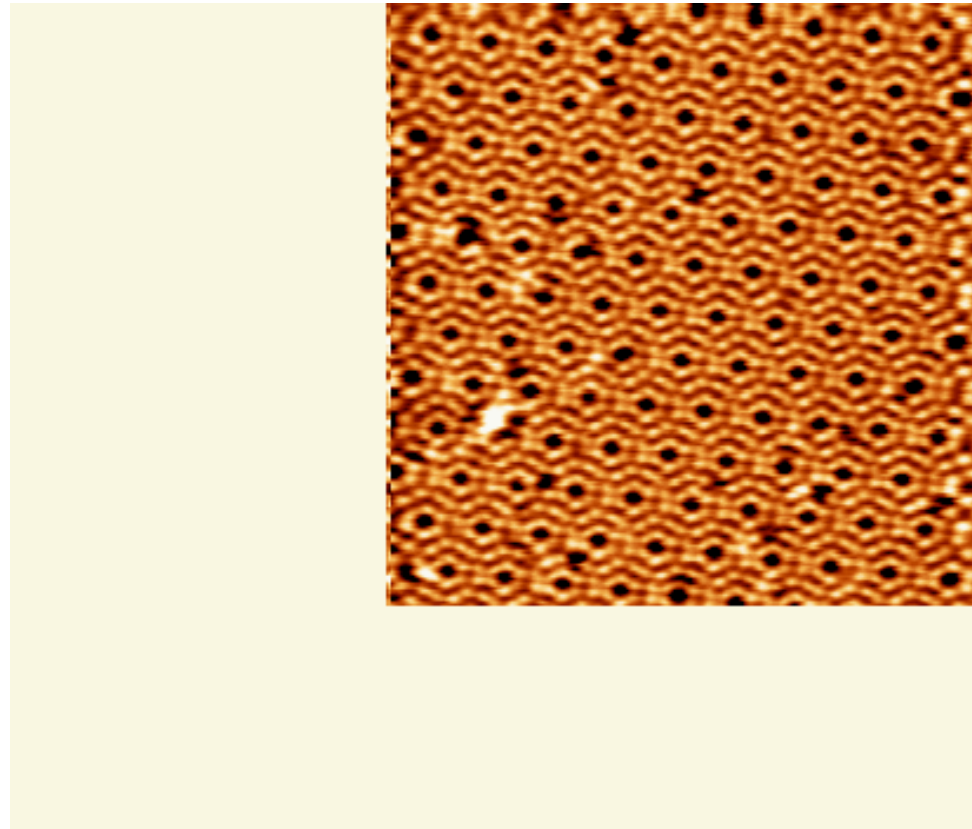


Marcel Rost and
Vincent Fokkema



Live growth: Mo deposition on Si(111)

initial stages: *silicide formation*

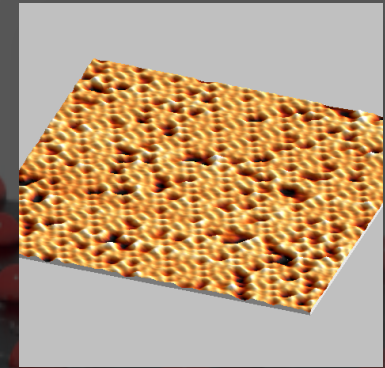
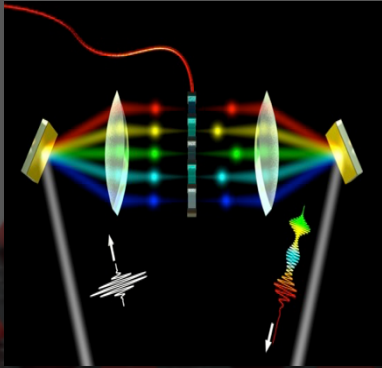


30 nm x 30 nm 1.7 s/frame
0-0.1 nm Mo

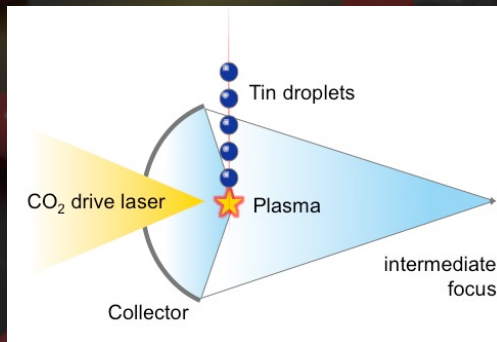


Marcel Rost
Vincent Fokkema

Advanced Research Center for Nanolithography (ARCNL)



Lots of jobs: *PhD students*
postdocs
tenure trackers
senior staff members
technicians



www.ARCNL.nl

