

Group video



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Group homepage

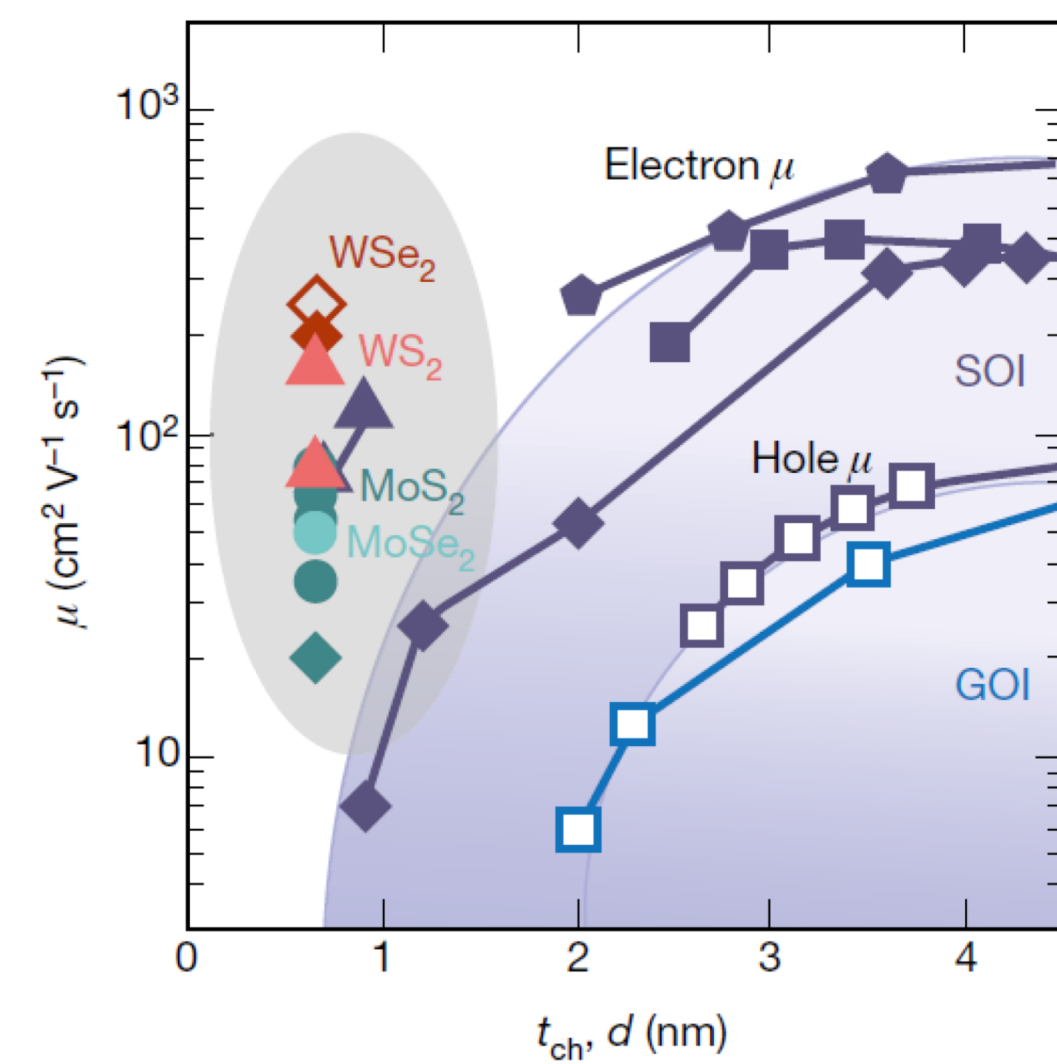
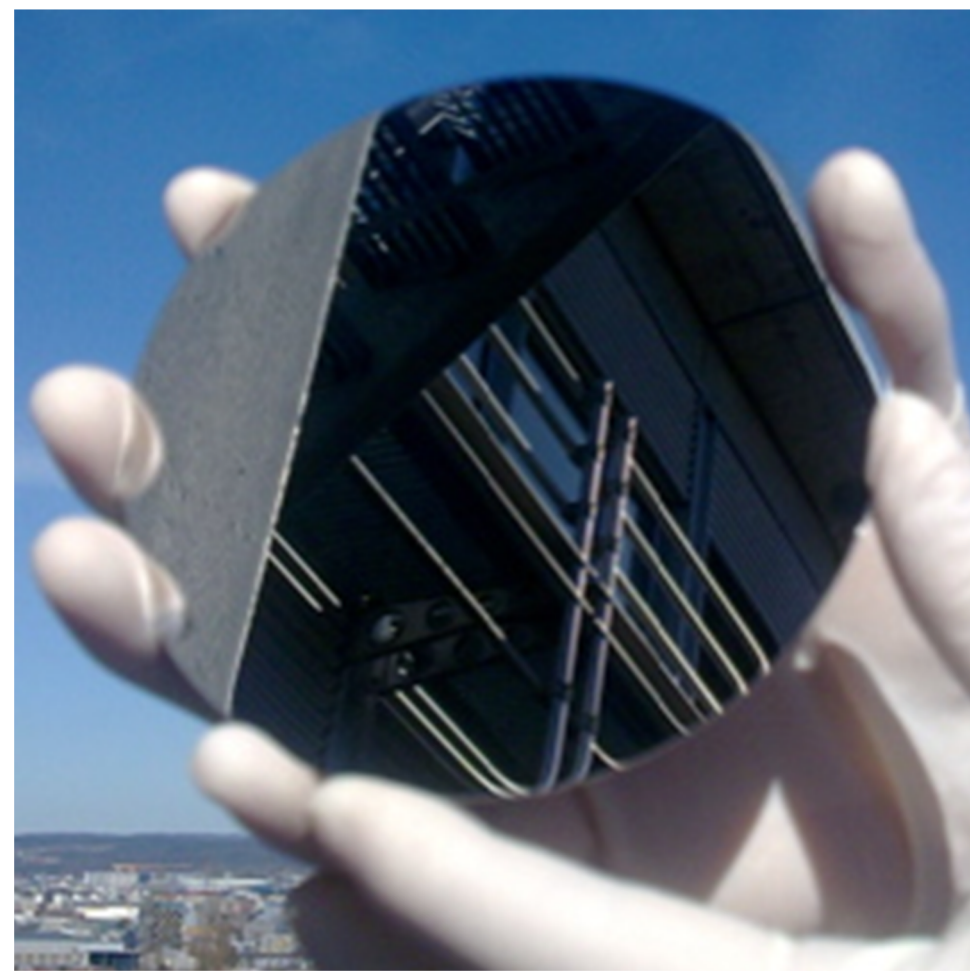


Open day of Physik-Institut 20231123-24

Designing, manipulating and measuring nano stuff? Sounds cool, doesn't it? We investigate fundamental processes on surfaces and apply our knowledge to build, measure and improve our own nanoscale-functional units, like single atomic layers and not so-small molecules.

## Systems

### Beyond silicon: 2D Boron Nitride



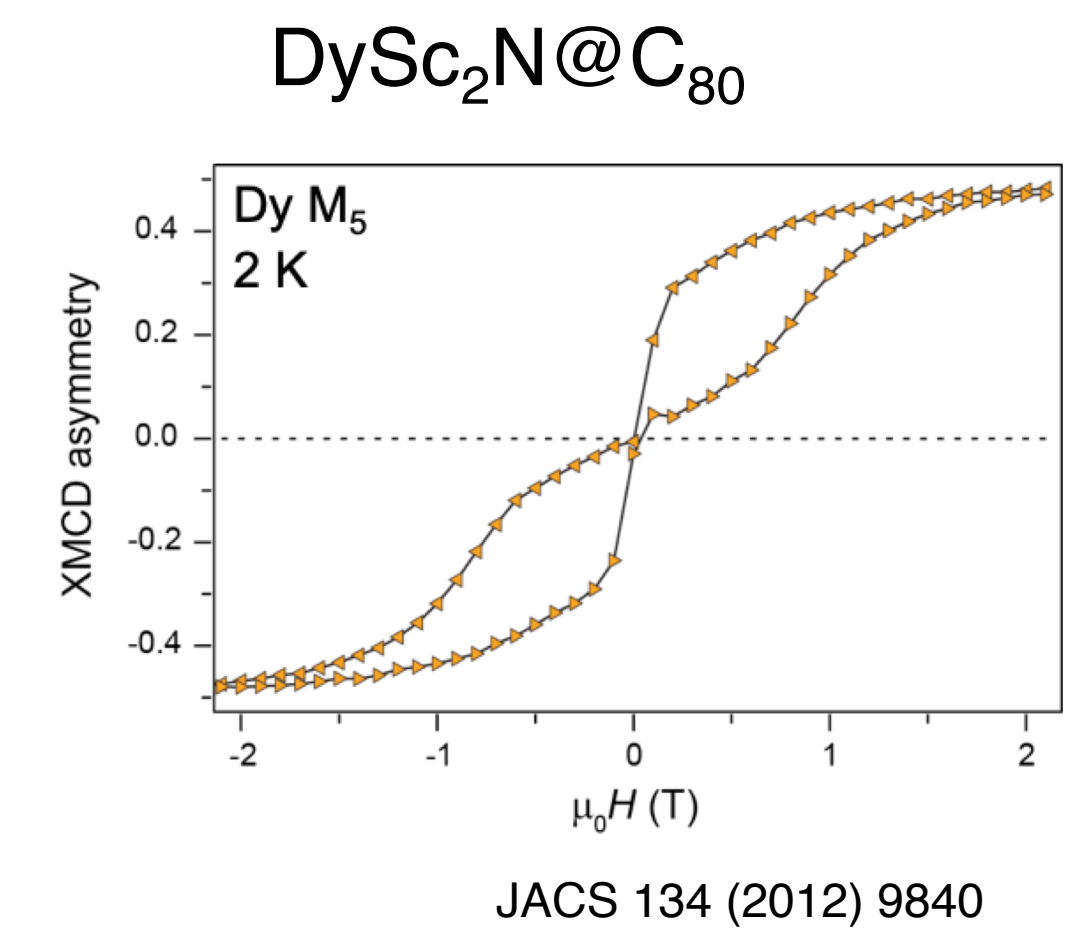
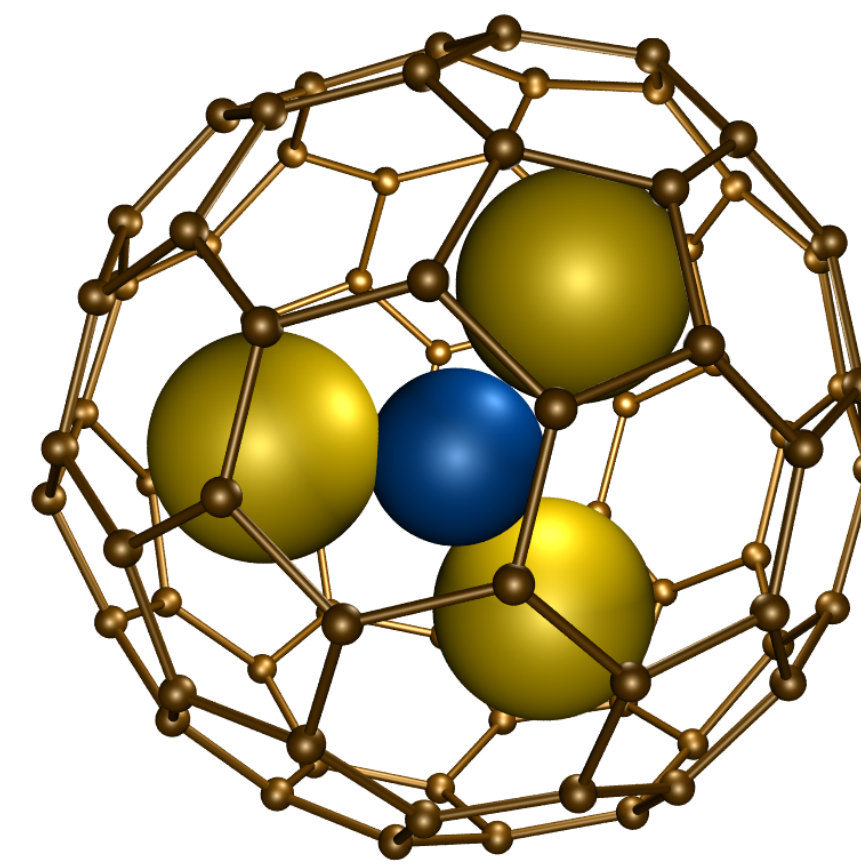
The semiconductor problem: Nanometer thin silicon is insulating, while two-dimensional (2D) materials keep their conductivities. [1]

We fabricate scalable wafer-scale state-of-the-art BN with chemical vapor deposition (CVD).

[1] D. Akinwande *et al.*, Nature 573, 507-518 (2019)



### Endofullerenes: 0D Magnets



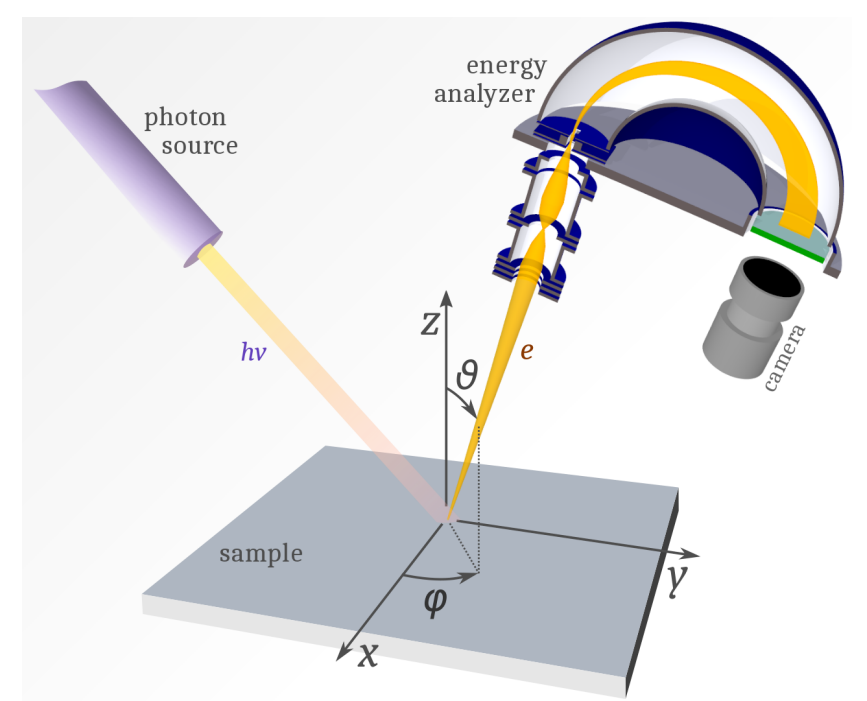
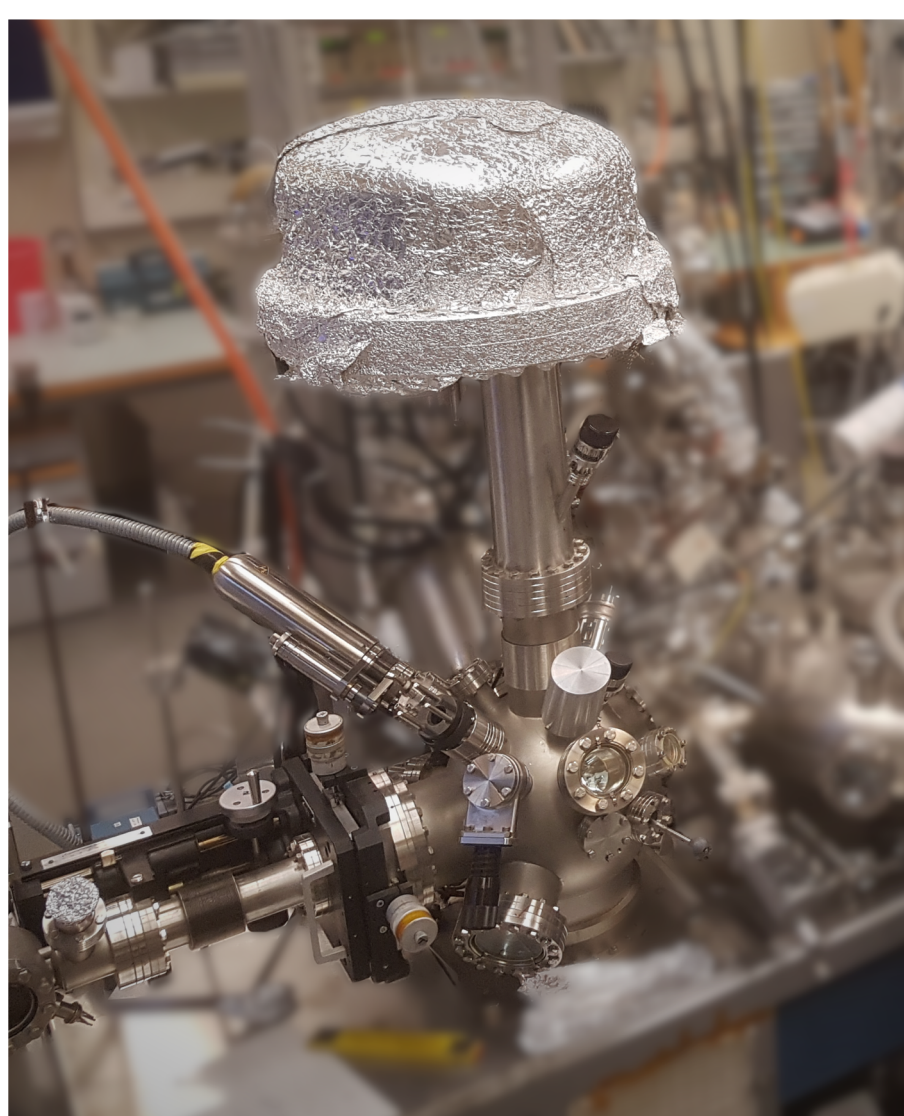
Single molecule magnets (SMMs): Nanometer spin systems that may be applied in quantum objects like Qubits [2].

We try to control the endohedral units with electrical fields.

[2] M. Leuenberger *et al.*, Nature 410, 789-793 (2001)

## Methods & Results

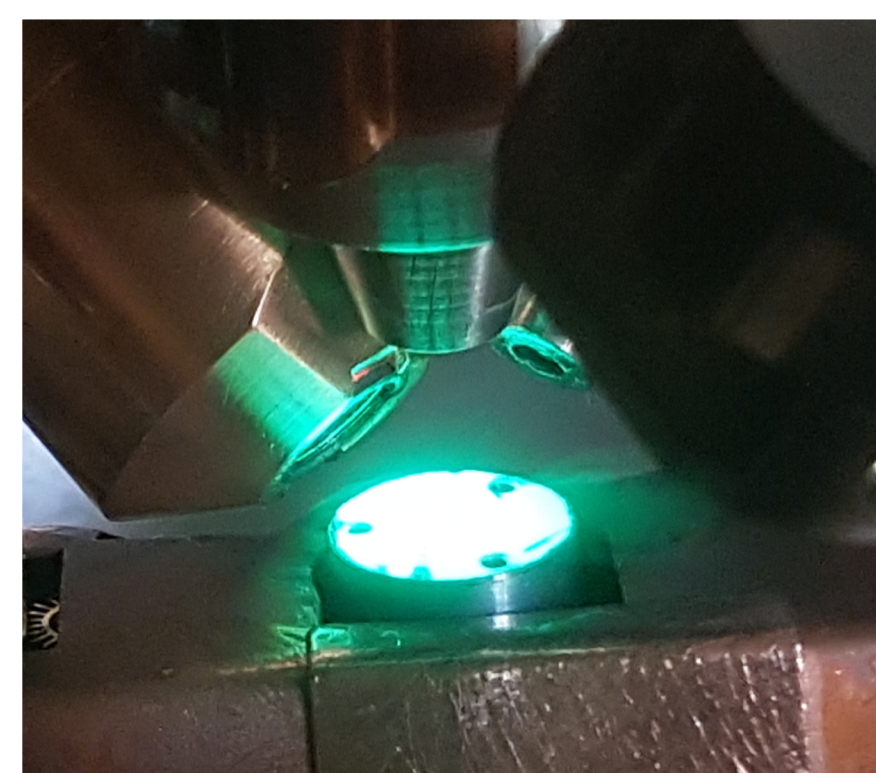
### Photoelectron spectroscopy and X-ray absorption spectroscopy



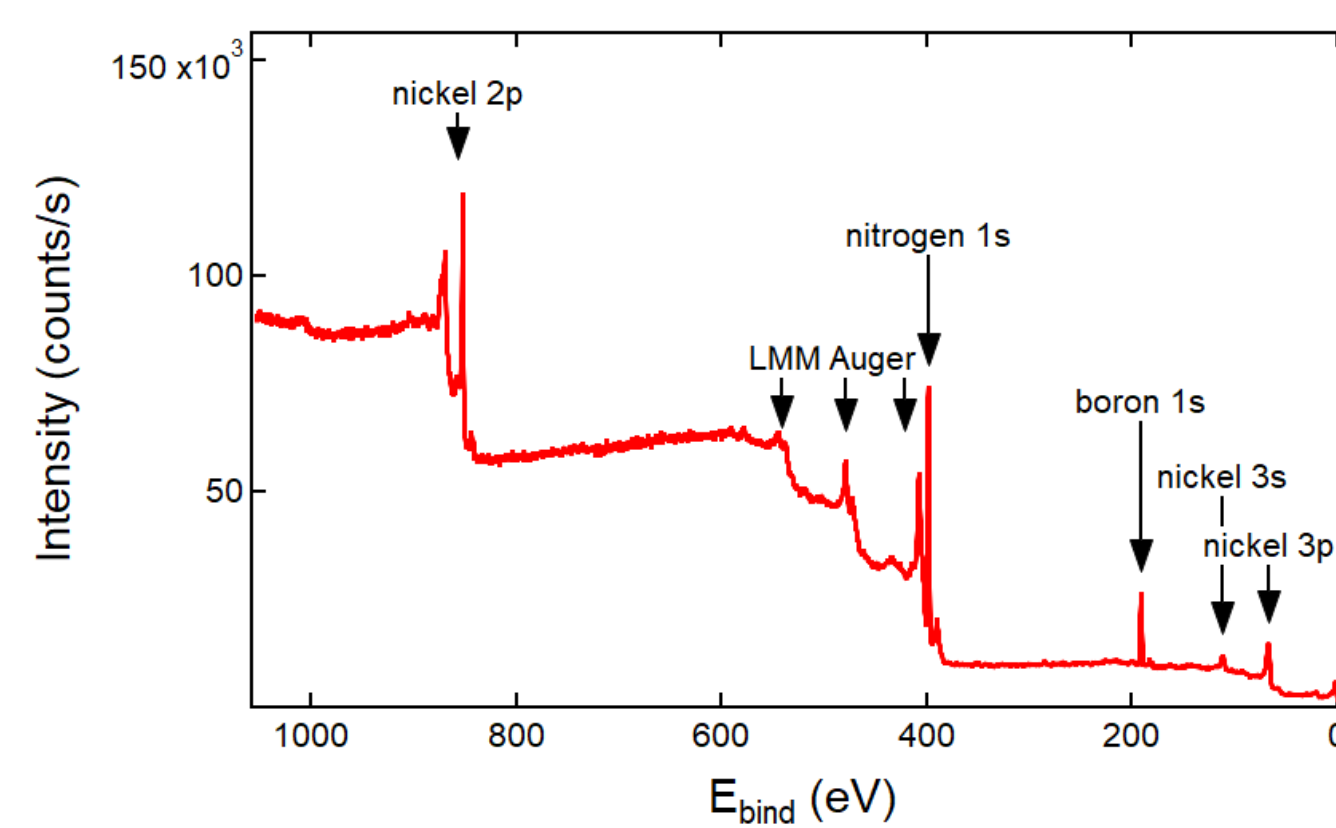
$$E = \hbar\omega$$

photoelectron spectrometer as **the tool** for surface analysis

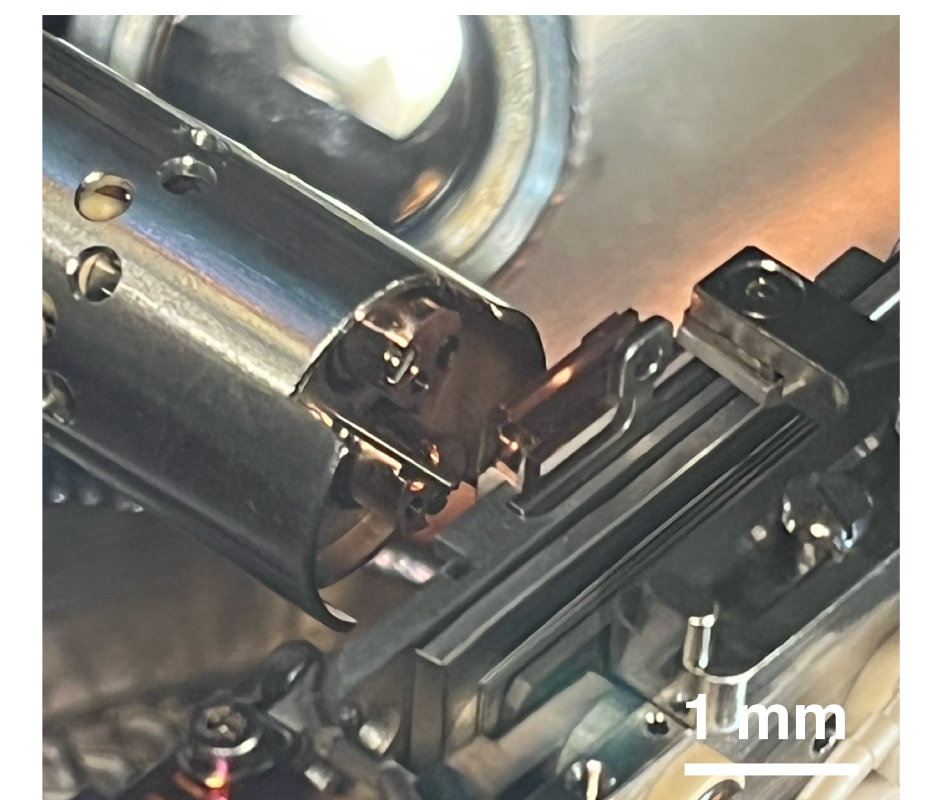
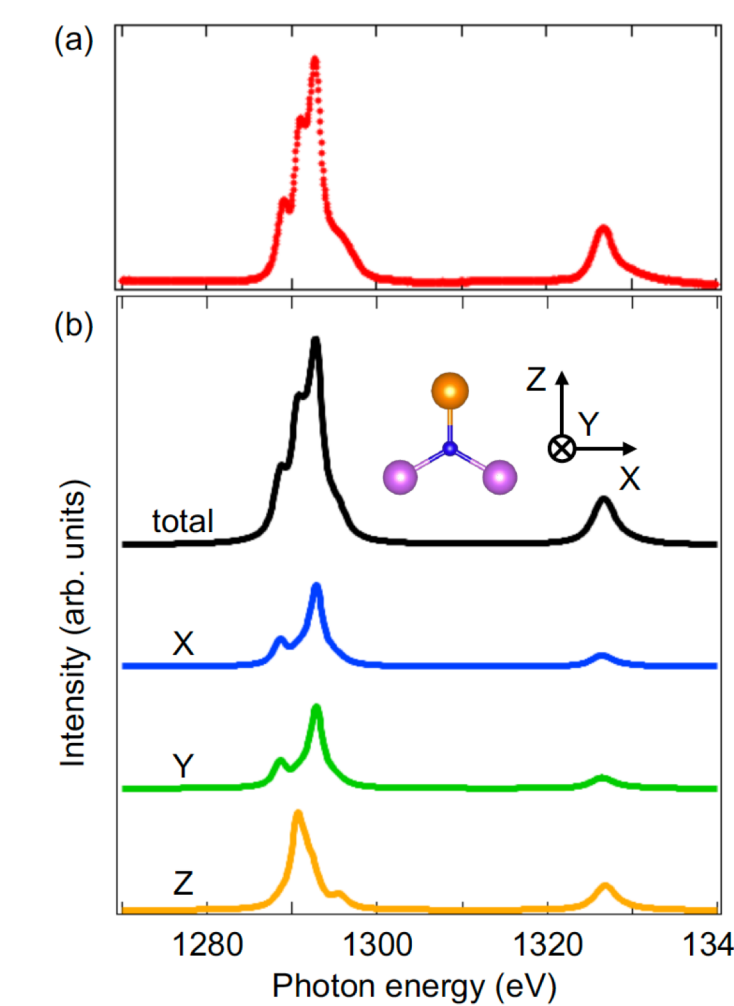
The kinetic energy of the emitted electrons allows to determine the elemental composition of the surface.



sample excitation with soft x-rays



- X-ray linear dichroism for the determination of the molecular orientation.
- SMMs like HoLu<sub>2</sub>N@C<sub>80</sub>, Tb<sub>3</sub>N@C<sub>80</sub>, Dy<sub>2</sub>ScN@C<sub>80</sub> etc. are evaporated by a Low-Temperature Nanogram Evaporator (LoTNE).



LoTNE with sample during evaporation

[3] R. Sagehashi *et al.*, PRM 7,8, 086001 (2023)

## Scalable UHV-CVD to fabricate high-quality boron nitride materials for 2D electronics

borazine

hydrogen

h-BN

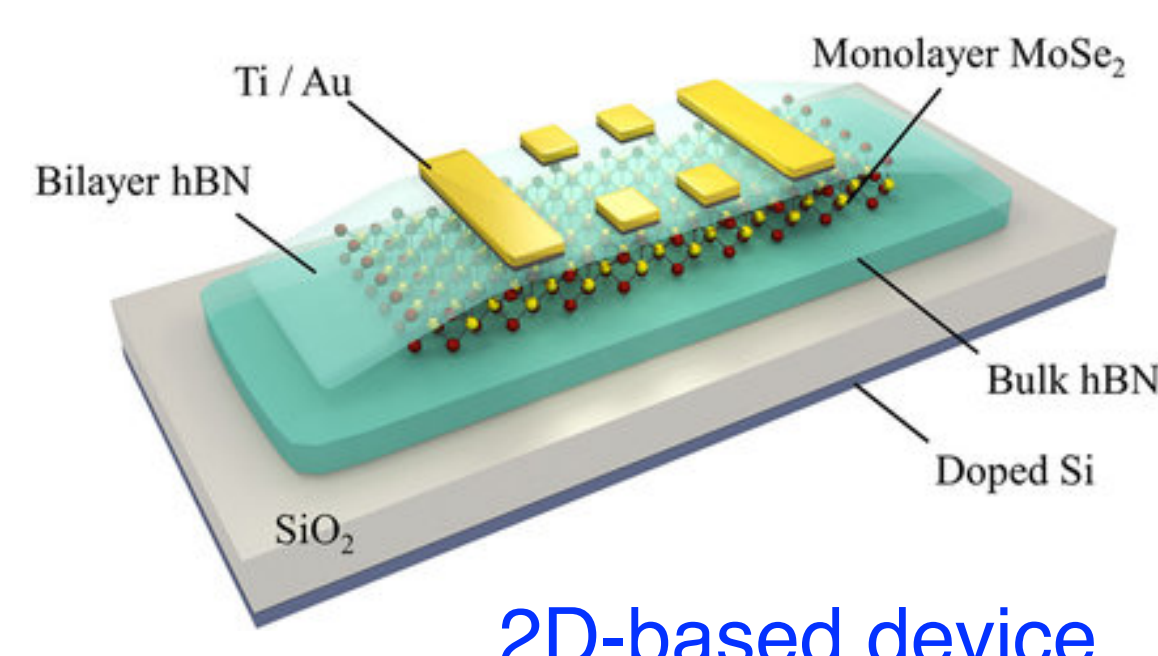
1050 K

3.2 nm

13×13 BN  
12×12 Rh

Rh(111)

M. Corso *et al.*, Science 303 (2004)

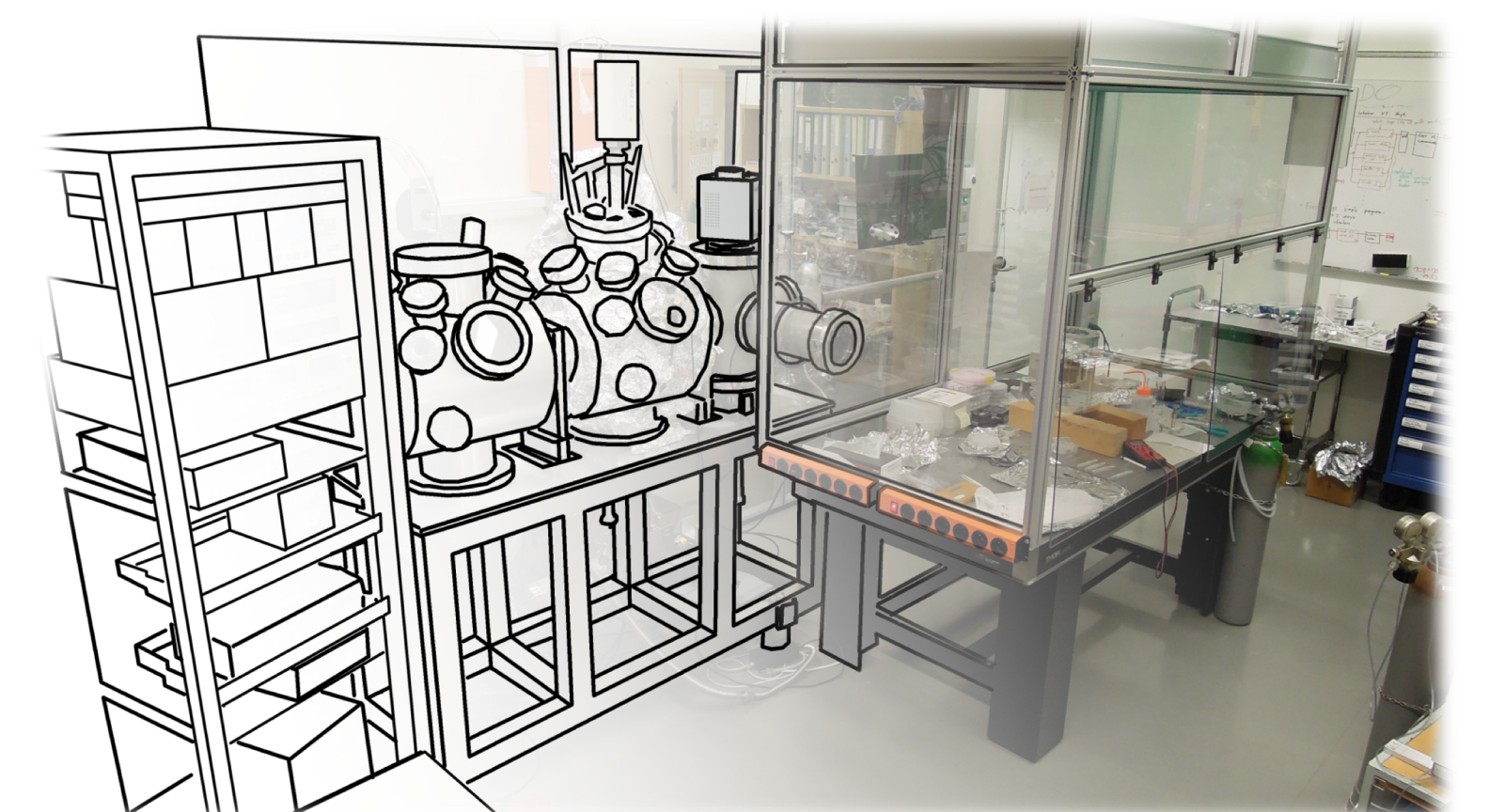


2D-based device

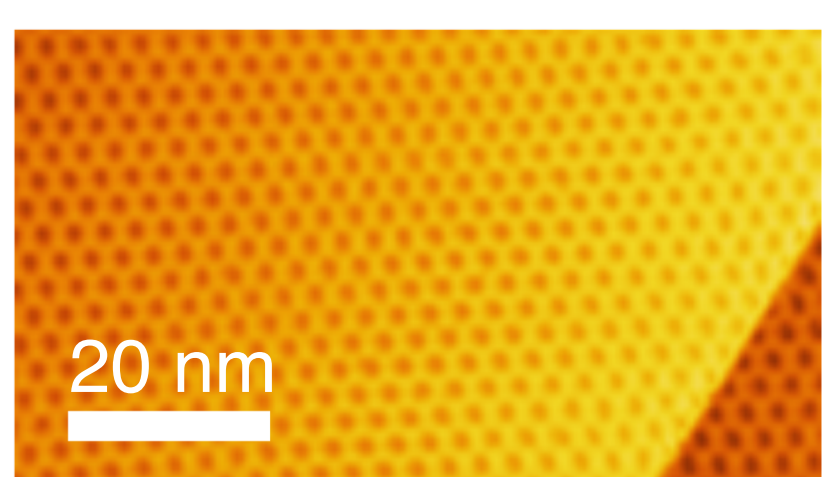
T. Ghiasi *et al.*, 2D Mater. 6, 015002, 2019

h-BN encapsulation

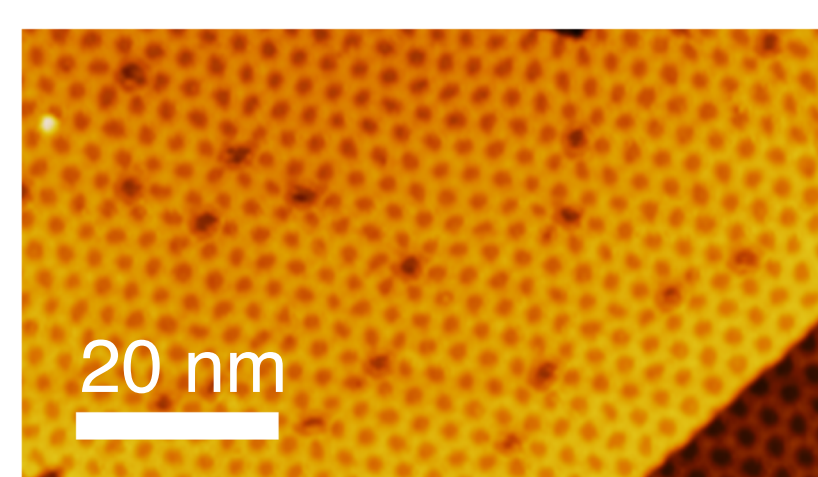
function of h-BN



home-made 4-inch CVD infrastructure



h-BN nanomesh on Rh(111)



nanovoidal BN (v-BN)

UHV-CVD surface fabrication knowledge since 1997

- h-BN is called wonder material due to its flexibility, transparency, strong mechanical properties and excellent chemical stability.
- 2D-BN is the key encapsulation material for next generation of electronics.



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## Thesis Projects: Contact the group