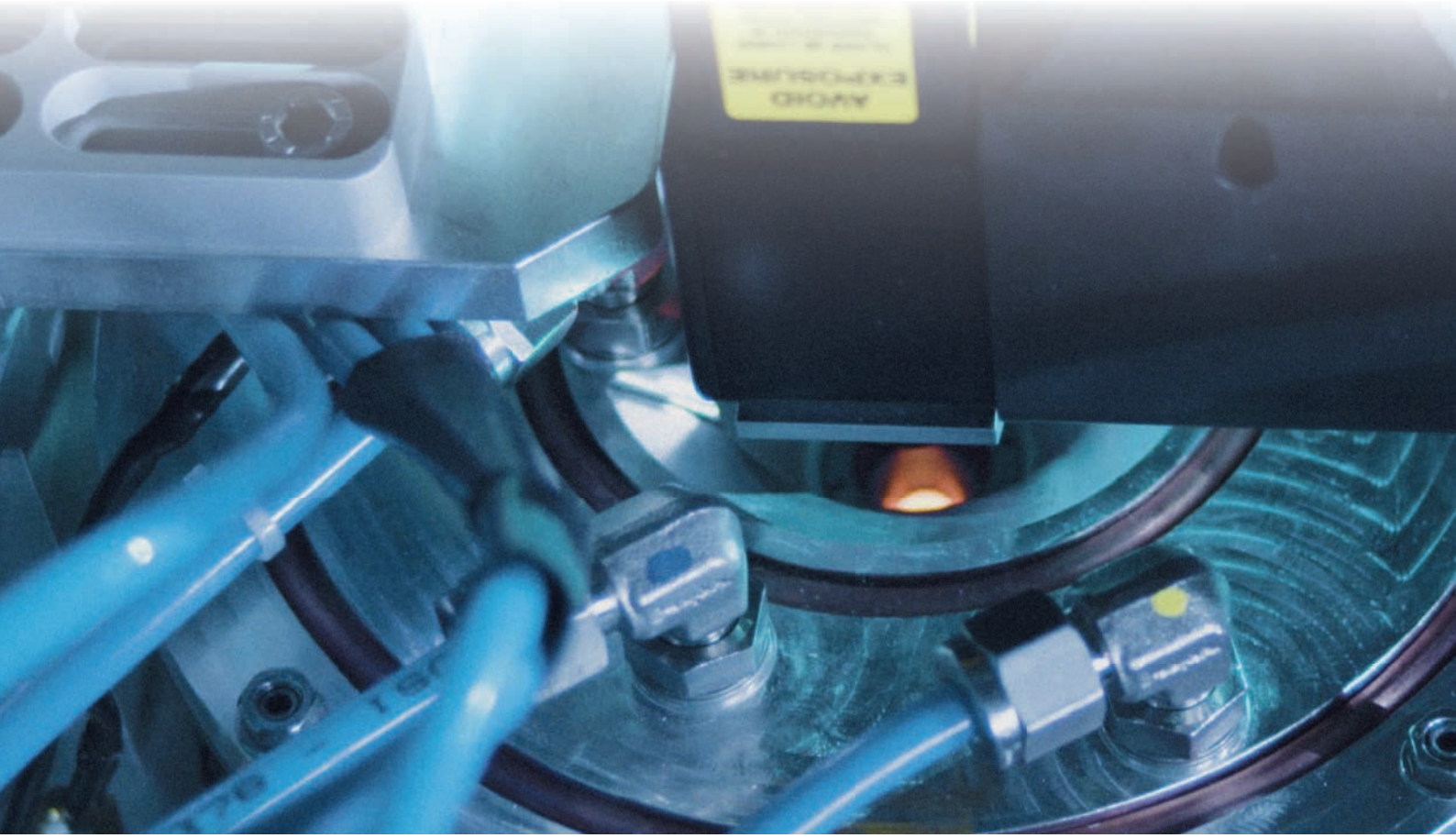
Research CVD systems with in situ microscopy



Gas

UHV - >1bar

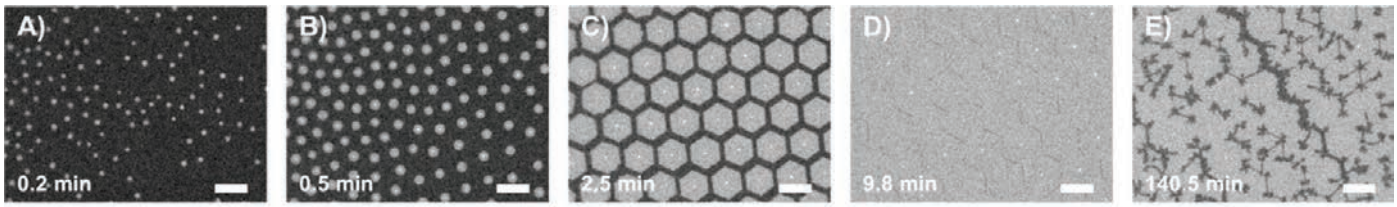
RT - 1200 °C

Application fields:

- controlled 2D material growth
- catalysis on (liquid) metals
- graphene growth
- high temperature microscopy

LPM
enabling discovery

Application example: direct visualization of graphene growth



See and measure the nucleation distribution and formation of 2D materials and other thin layers during growth in the reactor.

Shown are images from live capturing of the development of graphene flakes during a nucleation, growth, and etching experiment.

Figure (A-D): images of the nucleation and growth of graphene on liquid copper; figure (E): etching of the same layer.

Check out the movies in the supporting information:
DOI:10.1021/acsnano.0c10377

Microscopy under process conditions

The unique design of the reactor's gas flow allows continuous observation of hot and evaporating samples during exposure to the gasses. The sample temperature can get as high as 1200 °C.

This makes the system not only a perfect match for monitoring of 2D material growth, but also for imaging of processes such as corrosion, melting, alloying, segregation or surface roughening at very high temperatures.

The possiblitiy of using the well-known microscopy techniques at very high temperatures opens up the discovery and investigation of new phenomena in the fields of material science, chemistry, geology etc.

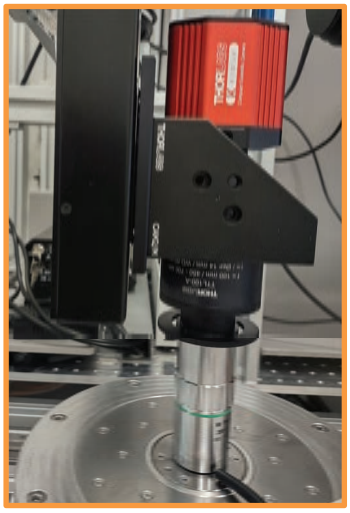
The special window cooling technology allows to study materials even above their melting point while maintaining the transparency of the window and keeping the objective cold.

Cross-sectional view of a reactor showing an optical microscope system with objective on top, sample heater stage at the bottom and the reactor volume with special designed structures to deflect the gas flow. This gas flow design protects the optical port and the beryllium side walls for this SXRD compatible reactor.

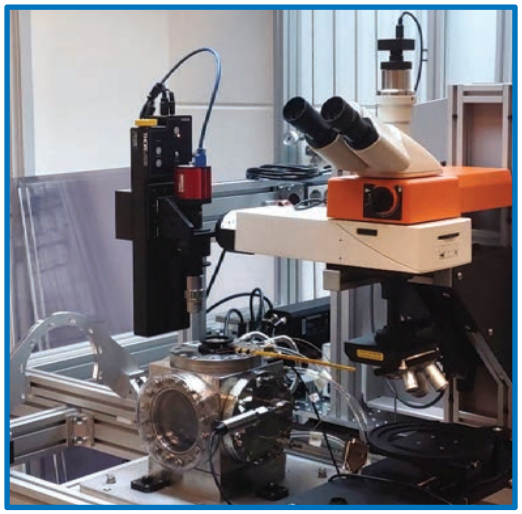
The color coding indicates the Cu vapor distribution in the reactor for a given gas flow rate when the Cu sample is heated above its melting point.

Patent application no: PCT/EP2020/058569

CVD reactors for R&D



Small reactor with flat top flange optimized for use under exisiting inspection instruments.

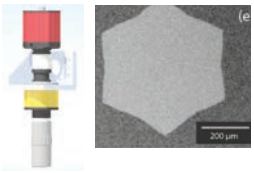


Reactor with CF flanges for interfacing with other vacuum equipment and side windows.

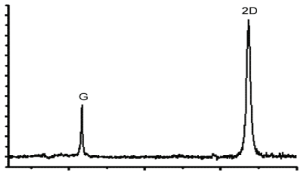
Custom reactors. Shown is a reactor with beryllium side walls for use on synchrotron SXRD setups.

	Small reactor	CF reactor	Custom reactor
Max sample diameter	26 mm (1")	51 mm (2") other sizes available	custom, typically 1"-2"
Reactor material	Aluminum / Stainless Steel	Stainless Steel	custom
Sample materials	All common metals and ceramics, including Galllium		
Sample temperature	> 1200 °C		
Heating power	~0.5 kW	~1.0 kW	custom
Gas compatibility	Noble gasses, H2, N2, CH4, CO2. Other gasses on request		
Top window - material	Quartz, sapphire, other material on request		
Top window - sample distance	17 mm	19 mm	>14mm
Top microscope - FOV diagonal	7 mm diagonal for 2.5x magnification 1.75 mm diagonal for 10x magnification		
Top microscope - Numerical Aperture (NA)	0.14 for 2.5x magnification 0.42 for 10x magnification		
Side window	NA	Standard CF viewports	custom, e.g. Beryllium
Control Software	Possibility to run automated recipes		

Architecture of CVD systems



optical microscopy

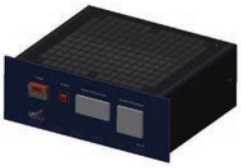


Raman spectroscopy

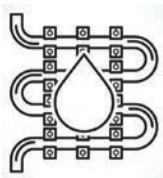
flow and pressure control

reactors with inspection ports

gas analysis (MS)



temperature control



system cooling

automated and remote process control, system monitoring, and data acquisition

Contact us for customization and options

LPM
enabling discovery

Leiden Probe Microscopy BV
Kenauweg 21
2331 BA LEIDEN
The Netherlands
info@leidenprobemicroscopy.com
+31-71-2035061