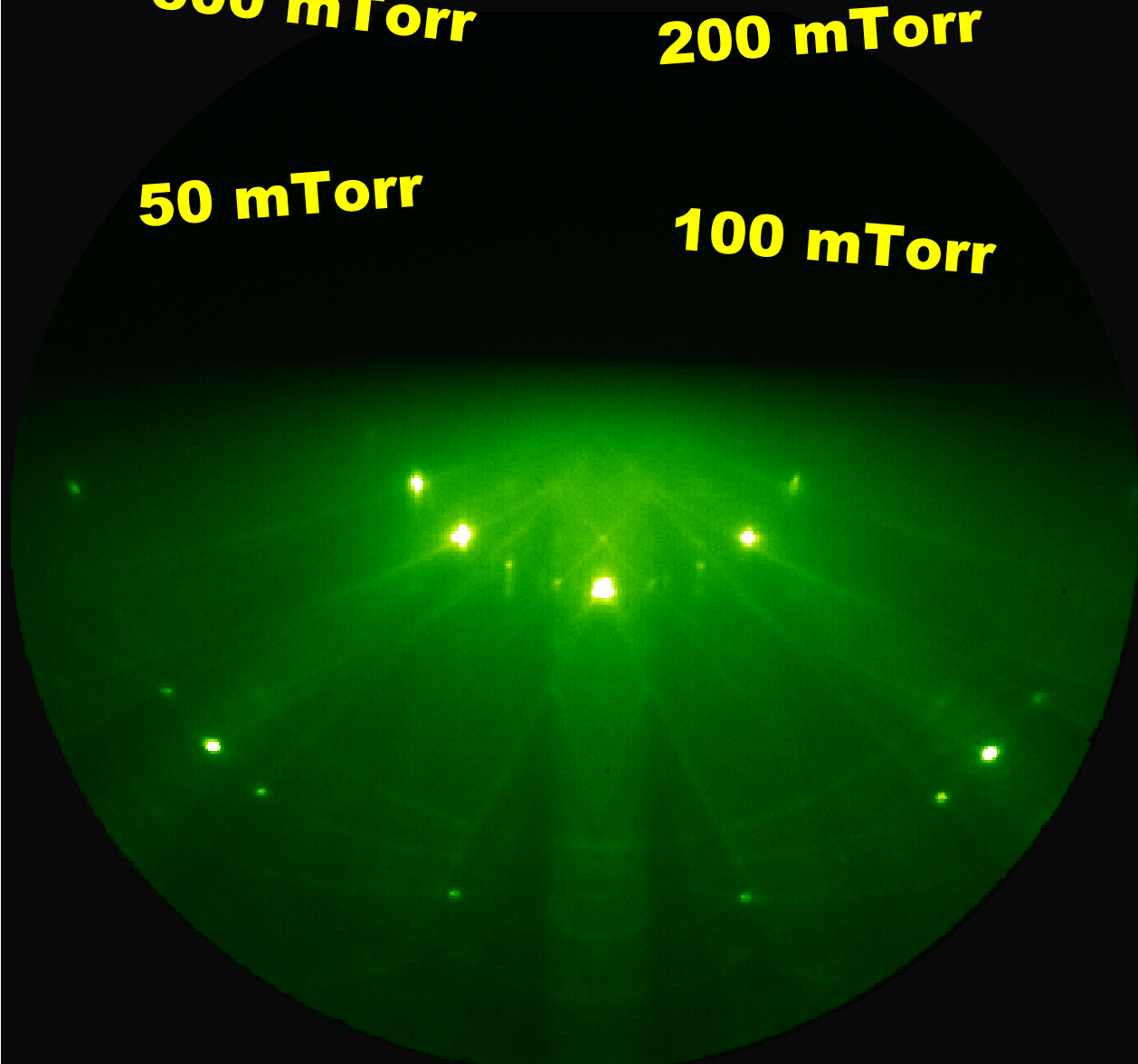


300 mTorr

200 mTorr

50 mTorr

100 mTorr



- Works up to 500 mTorr (typ.)
- Dual differential pumping
- Powerful manipulator with smooth and precise adjustments for tilt and distance
- Automated safety gate valve for the RHEED electron gun

SURFACE

HP-RHEED

RHEED at 300 mTorr?

RHEED (reflective high energy electron diffraction) is a powerful tool to monitor the deposition of thin films. An electron beam hits the substrate/film at a very small angle to the surface, so the electrons don't penetrate deep into the material. Diffraction takes place in the top few atomic layers of the sample, so the resulting diffraction pattern contains information about the film surface. RHEED works well in UHV processes like MBE (molecular beam epitaxy), where the chamber/process gas pressure is very low – typically below 10^{-6} Torr. The pressure range can be extended somewhat by pumping the RHEED gun (electron source) differentially to prevent cathode filament degradation. But at the process pressures present in a **PLD/Laser MBE** system (normally up to 1 Torr), the mean free path length of the electrons is too short: The additional scattering will blur the RHEED pattern and render it unusable, as the electron gun is typically mounted 30...40 cm away from the substrate.

SURFACE offers a solution for this problem: The **SURFACE HP-RHEED** system. Here the electron beam is enclosed on 90% of its way in a differentially pumped tube. The electron beam is exposed to the deposition chamber pressure only very close to the substrate, so a small spot size and uniform electron energy are maintained at the substrate surface.

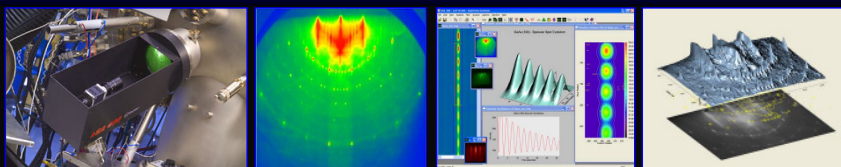
The SURFACE HP-RHEED System

On the electron gun side of the system, a standard RHEED electron gun is mounted on a special manipulator. Two differential pump stages reduce the pressure from 300 mTorr down to the 10^{-6} Torr range. A guiding tube encloses the electron beam up to a point near the substrate, where the beam leaves the tube through a small orifice.

Because the electron beam now has to be aimed through the two orifices needed for the dual differential pumping, beam adjustment solely by the magnetic lenses of the electron gun is no longer sufficient. To compensate for this, the **SURFACE electron gun manipulator** provides z-motion (1" backwards retraction from the substrate) and $\pm 3^\circ$ tilt in two axes. A specially designed support frame holds the gun assembly, so that these adjustments can be done **easily and with high precision**. Together with the rotation and tilt features of the **SURFACE** substrate manipulators or laser heaters, this allows perfect alignment of the diffraction image.

A small automatic gate valve built into the manipulator protects the RHEED gun filament from excessive pressure. On the screen side, a standard RHEED screen can be used.

k-Space kSA 400 RHEED Analysis Software

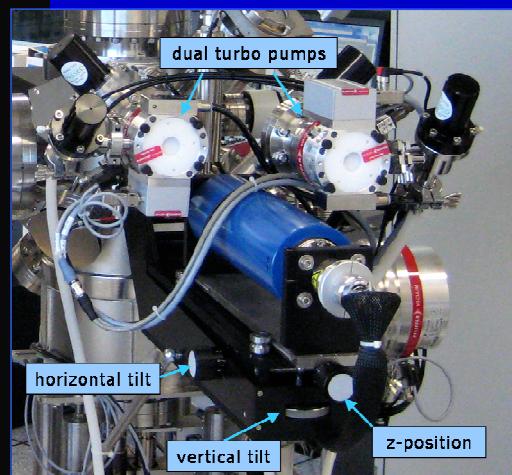


Part of the **SURFACE HP-RHEED** system is the leading edge analytic hard- and software from k-Space. This makes the RHEED system the perfect tool to monitor growth rate, lattice spacing/strain, surface coherence, and surface structure/reconstruction. Optionally, the RHEED electron gun can also be controlled via a k-Space software plugin.

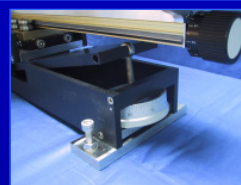
R-DEC RDA-003G RHEED Electron Gun

The standard RHEED gun for the **SURFACE HP RHEED** is the RDA-003G together with the RDA-004P power supply. This combination offers up to 30 keV electron energy, a maximum beam current of 160 μ A, and a beam diameter of max. 90 μ m. Supply and controls for the magnetic focus and deflection lenses are built in.

HP-RHEED with dual turbo pump stage



Electron gun manipulator for precise θ_x , θ_y , z positioning of the electron beam



Internal safety gate valve to close the gun if chamber pressure exceeds limit



RDA-003G RHEED electron gun

Specifications:

Maximum pressure:	up to 500 mTorr
1 st pumping stage:	60 l/s turbomolecular pump, or pump of PLD system (depending on application)
2 nd pumping stage:	60 l/sec turbomolecular pump
Backing pump:	2 m ³ /h diaphragm pump
Safety:	Built-in gun vacuum protection valve
Gun manipulator:	
z-retraction:	1"/25 mm
x/y tilt:	$\pm 3^\circ$

SURFACE

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