

Precision and Vacuum Technology



5 mbar XPS/UPS SYSTEMS

Versatile surface analysis tools for researchers

System dedicated for XPS /UPS experiments in pressure range from 10^{-10} mbar up to 5 mbar with controllable sample temperature. Equipment provides full PLC protection and software control including clear visualization of the machine state, data acquisition, control of all integrated devices, power supplies and ancillary.

X-ray source with monochromator RMC50 (HP version)

Hemispherical energy analyzer EA15-HP1

Analysis chamber

X-ray source RS 40B1 (HP version)

4/5/6-axes manipulator with heating and cooling possibility

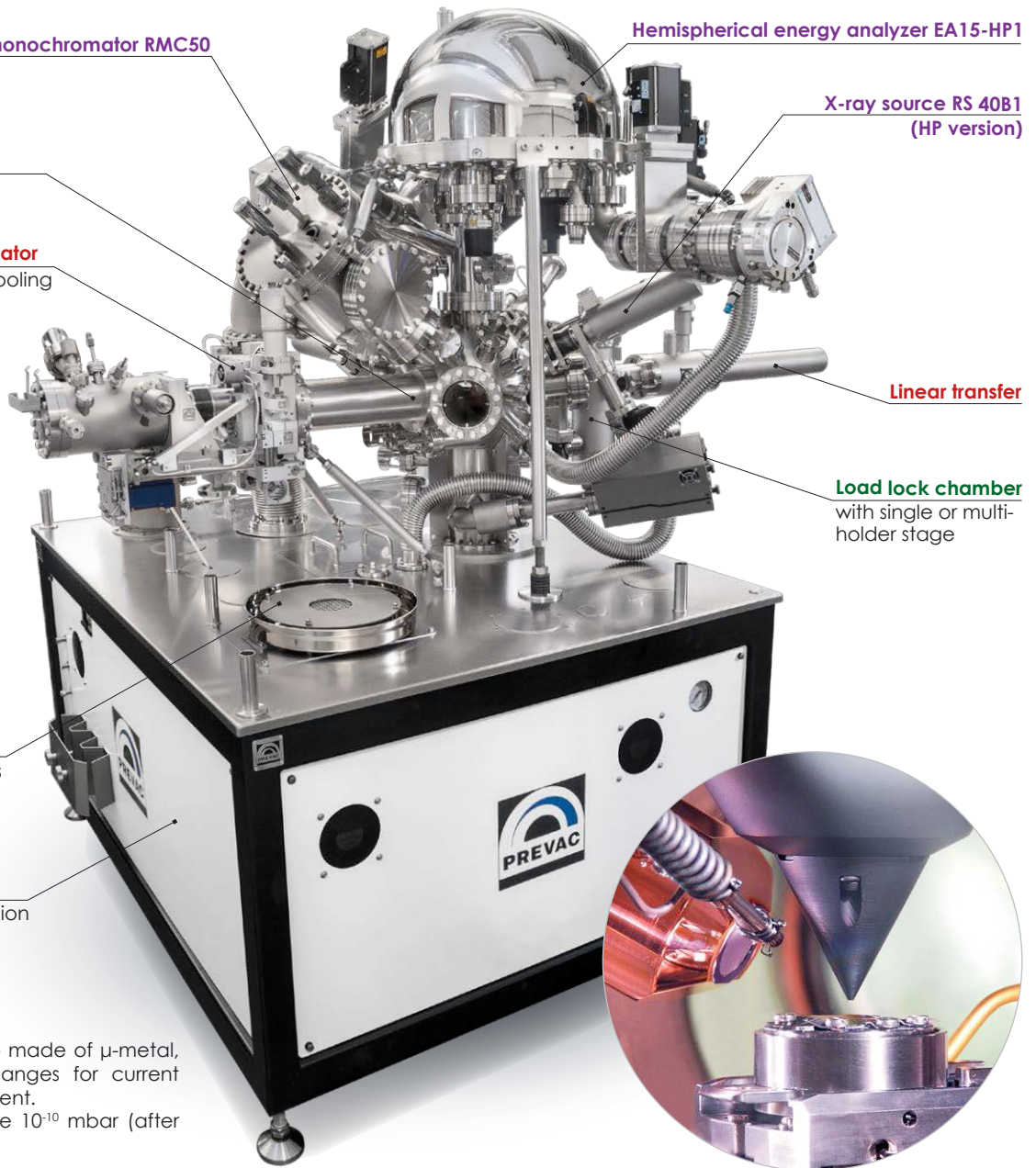
Linear transfer

Load lock chamber with single or multi-holder stage

Built-in heater for bakeout process

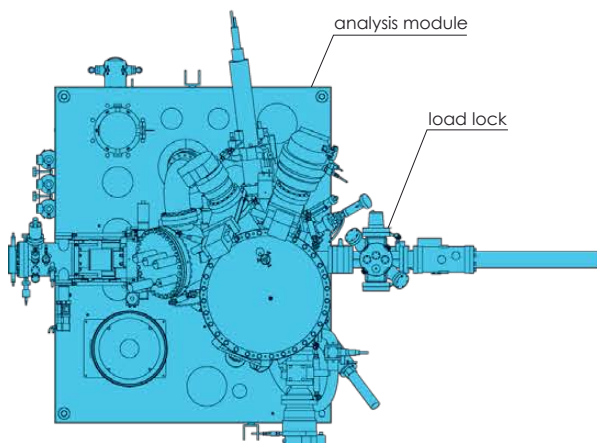
Modular frame prepared for extension

Analysis chamber - made of μ -metal, with connecting flanges for current and further equipment. Base pressure range 10^{-10} mbar (after bakeout at 120 °C).

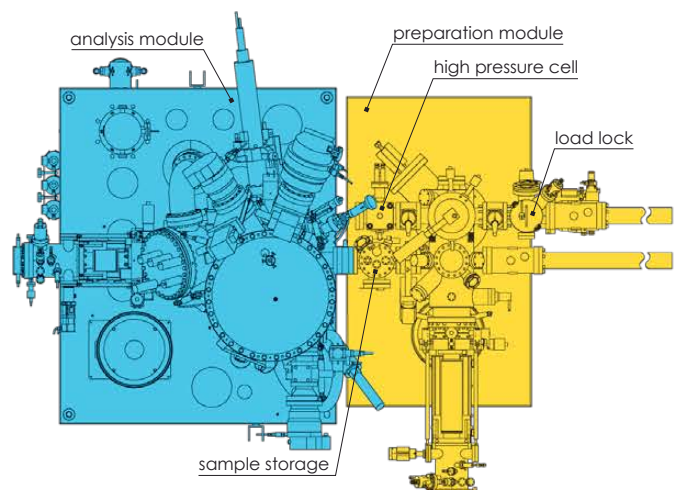


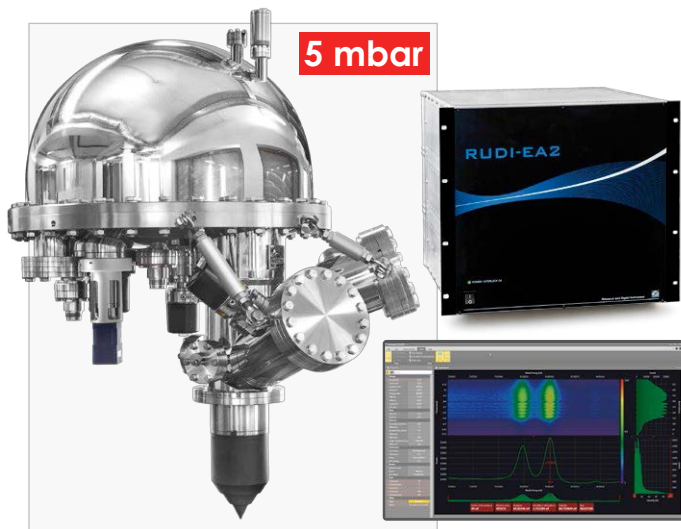
SYSTEM MODULARITY

BASIC CONFIGURATION



CONFIGURATION WITH PREPARATION MODULE, WITH LINEAR TRANSFERS





5 mbar

PREVAC EA15-HP1 ANALYSER

EA15-HP1 hemispherical energy analyser (XPS/UPS) - equipped with a total number of 11 slits, the analyser offers the possibility to choose between best energy resolution and best intensity. Mean radius: 150 mm. Kinetic energy range: 0-2000 eV.

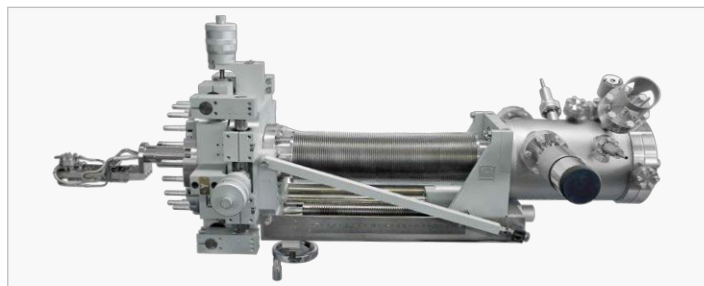
RUDI-EA2 - Very stable and low noise high-voltage power supply.
SPECTRIUM - a progressive and optimized software tool in regard of handling and intuitive graphical interface.



X-RAY SOURCE with MONOCHROMATOR

The RMC50 X-ray monochromator source (HP version) is based on an single ellipsoidal quartz crystal. The two anode types (Al/Ag) radiation can be monochromized with one single crystal.

- Excellent energy resolution (line width < 0.25 eV)
 - High photon intensity
 - Two spot sizes
 - Satellites and ghosts peaks are eliminated
- Monochromator is provided with electronic set (emission controller, cooling box and HV power supply for operating both RMC50 and RS40B1 X-ray source).



MANIPULATOR - ANALYSIS CHAMBER

Depending on the application, the manipulator in the analysis chamber can offered as 4, 5, 6 axis.

- High precision manipulation in all directions
- Wide range of temperatures (depend on application), e.g.
 - cooling down to 90 K (LN₂)
 - heating up to 2000 °C (EB), 1000 °C (resistive), 1400 °C (laser heating)
- Fully motorised or manual
- Fully software controlled



UV SOURCE UVS 40A2

The UV Source (UVS) is a high intensity Photon Source that can be operated with a variety of discharge gases. The UVS is water cooled for maximum stability and features fully interlocked safety circuitry.



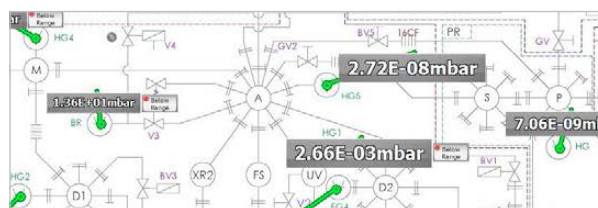
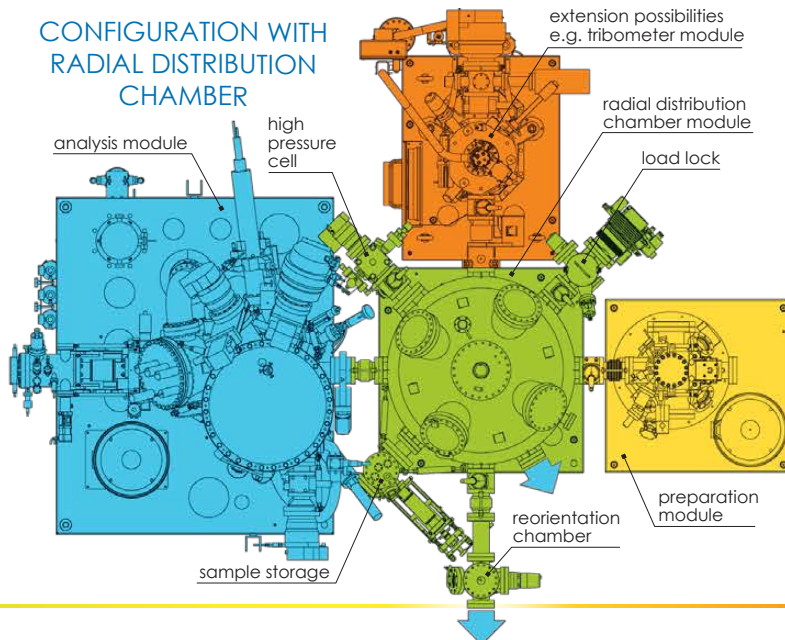
LOAD LOCK

Fast into chamber with single or multi-holder stage. Can be equipped with preliminary halogen heating.

SAMPLE HOLDERS

Wide range of sample holders available (over 200 types) e.g. for quartz balance, high pressure cells, powder materials and many other.

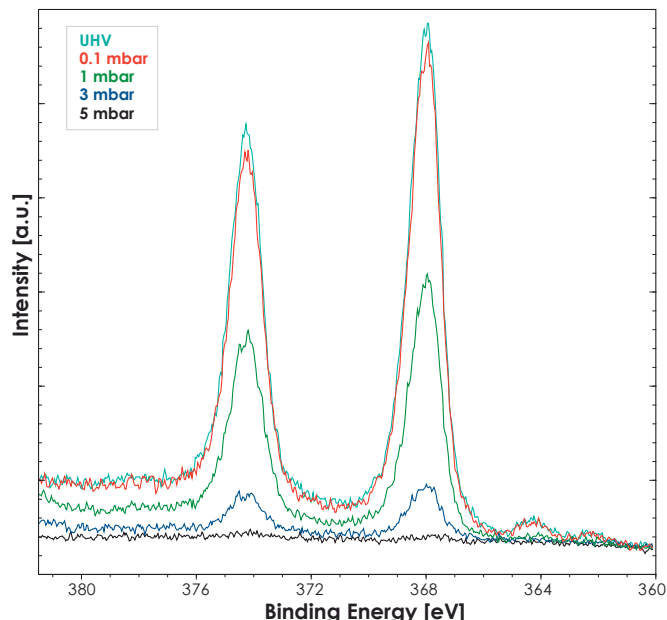
CONFIGURATION WITH RADIAL DISTRIBUTION CHAMBER



SOFTWARE

Software provides control of the system, visualisation of machine state, data acquisition, possibility to control other devices connected to the system like UV power supply, etc. System is controlled and protected by PLC controller.

Spectra of silver Ag3d peak, obtained by PREVAC EA15-HP1 analyser and PREVAC X-ray source RS 40B1 (HP version), from UHV up to 5 mbar, excitation energy Al K α 1486.6 eV, 400W.



Innovative results of cutting edge researches achieved on PREVAC's High Pressure XPS (ESCA) system.

Mapping of Copper Oxidation States as a function of temperature at 1 mbar O₂

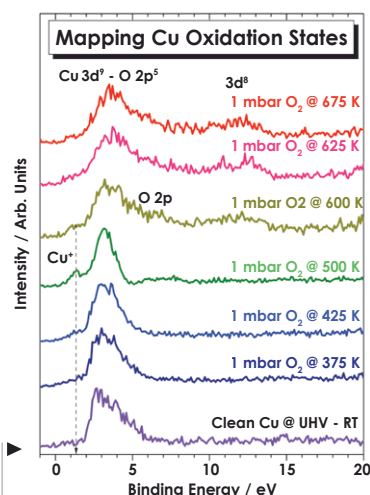
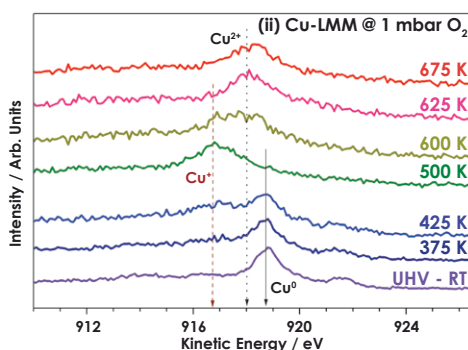
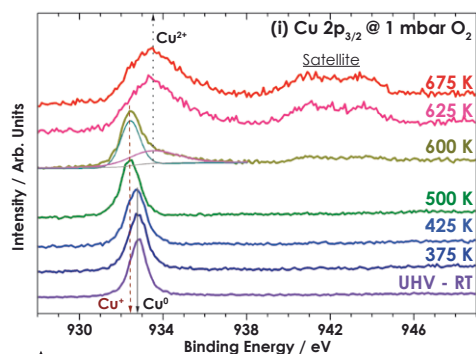
The Cu 2p, Cu LMM Auger level and valence band (VB) spectra recorded in the presence 1 mbar O₂ from RT to 675 K are shown in the attached Figures. The Cu 2p spectrum from a clean Cu surface obtained under UHV conditions and at RT immediately after Ar⁺ sputtering and annealing is shown for reference (bottom-most trace in all Figures). The Cu 2p_{3/2} core level spectrum centered at 932.8 eV (grey solid arrow) which is characteristic of metallic Cu remains unchanged until 425 K indicating that the metallic nature of Cu surface is retained until this temperature. Cu-LMM also shows corresponding feature at 918.8 eV.

On increasing the temperature to 500 K, a dramatic change in oxidation state to Cu⁺ (ie. Cu₂O) is evident from the shift observed in Cu 2p (to 932.4 eV), Cu-LMM (to 916.7 eV)

compared to metallic Cu features. A distinct feature appears at 1.2 eV with a narrowing of VB feature.

Further increase in temperature to 600 K shows features due to Cu₂O as well as CuO. This marks the beginning of oxidation of Cu₂O to CuO. A prominent satellite feature, typical for CuO (Cu²⁺ oxidation state), begins to appear along with a shift in Cu-LMM feature. Broadening of VB with O 2p features confirms the oxidation of Cu₂O to CuO.

Spectra recorded at 625 and 675 K fully supports the complete oxidation of Cu surfaces to CuO, and sufficiently thick CuO layers observed suggest the beginning of bulk oxidation towards CuO. Features typical for CuO were observed in all three spectra, such as 3d⁸ satellites in Cu 2p core level.



Core level spectra measured while exposing a polycrystalline Cu foil to 1 mbar O₂ at various temperatures. (i) Cu 2p, and (ii) Cu LMM.

High pressure valence band spectra recorded at 1 mbar O₂ and at different temperatures. Systematic conversion of Cu metal at UHV-RT to Cu₂O (at 500 K) and CuO above 500 K is observed in 1 mbar O₂.

Ref.: Kanak Roy, C. P. Vinod, Chinnakonda S. Gopinath, Design and Performance Aspects of a Custom Built Ambient Pressure Photoelectron Spectrometer Towards Bridging the Pressure Gap: Oxidation of Cu, Ag, and Au Surfaces at 1 mbar O₂ Pressure, *Journal of Physical Chemistry C* 117, 4717-4726 (2013).



XPS / UPS / ARPES



If you need any further information, please do not hesitate to contact our sales department

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