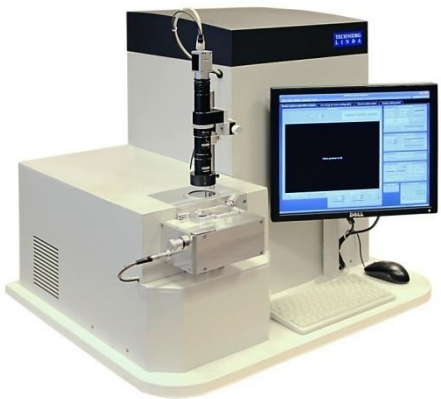
IV7 UniMill

Fully automated ion beam thinning system for TEM/XTEM sample preparation



- Fast thinning and gentle polishing/cleaning with the same instrument
- Fully automated ion source setup and ion mill operation
- Widest range of ion energies: from 100 eV to 20 keV using ultra-high-energy and low-energy noble gas ion sources
- Extremely high milling rates:
  900 µm/hour for monocrystalline Si at 20 keV and 30º
- Optional liquid nitrogen cooling

The new IV7 model of Technoorg ion mills has been designed for extremely rapid preparation of high-quality TEM/XTEM samples with unsurpassed high thinning rate. The design of the instrument enables both rapid milling with the ultra-high-energy noble gas ion source and final polishing and cleaning with the patented low-energy ion gun.

APPLICATIONS

The IV7 UniMill is recommended to users developing new materials or new sample preparation methods and due to its extreme milling rate it is also recommended for studying materials of very low sputtering rate, such as diamond, sapphire, etc. Its exclusive capability of producing damage- and artifact-free samples by low-energy ion bombardment provides unique opportunity to study real nanostructures in synthesized and natural materials in all fields of technical sciences and materials research.

STATE-OF-THE-ART ION SOURCES

The IV7 UniMill includes two independently controlled ion sources: one focused high- or ultra-high-energy ion gun and one focused low-energy ion gun.

High- and ultra-high-energy ion sources

Technoorg's high- and ultra-high energy ion sources provide the highest milling rate in the market. The ion gun operating up to 20 keV is especially designed for TEM sample preparation for materials of very low milling rate.

Low-energy ion source

The exceptional construction of the ion source allows to reach high beam current densities in the whole operating range. The beam of extremely low energy noble gas ions guarantees minimization of surface damage and ion beam induced amorphization.

Ion source control

All ion gun parameters including accelerating voltage and beam current are controlled automatically by a digital feedback loop, but they can always be changed manually during the sample preparation process. The initial values of the ion source parameters are set either automatically or manually and are continuously monitored and displayed by the computer.

AUTOMATED OPERATION

The IV7 model of Technoorg ion mills is provided with full computer control utilizing an easy-to-use graphical interface. All milling parameters including the electrode voltages, working gas flow, sample motion/tilt and further parameters of process timing and perforation detection can be stored or pre-programmed in arbitrary number of steps. This fully automated feature of the IV7 allows to produce high-quality samples with minimum user intervention.

ON-LINE MONITORING AND SUPPORT

The UniMill is supplied with a software extension for on-line technical support, which enables instant error detection and problem elimination via the Internet.

LIQUID NITROGEN COOLING

This feature reduces excessive sample heating during the ion bombardment. Thus, heat-sensitive materials can be prepared without destabilization of internal structures.

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TECHNOORG LINDA

SPECIFICATIONS

ION SOURCES

Ultra-high-energy ion source (optional):

- Ion energy: up to 20 keV, continuously adjustable
- Ion current density: <150 mA/cm^2
- Beam current: up to 250 µA
- Beam diameter: 100 - 300 µm (FWHM)
- Milling rate: 900 µm/h on c-Si at 20 keV and 30º angle of beam incidence

High-energy ion source (standard configuration):

- Ion energy: up to 10 keV, continuously adjustable
- Ion current density: up to 100 mA/cm^2
- Beam current: up to 140 µA
- Beam diameter: 200 - 500 µm (FWHM)
- Milling rate: 180 µm/h on c-Si at 10 keV and 30º angle of beam incidence

Low-energy ion source:

- Ion energy:100 eV - 2 keV, continuously adjustable
- Ion current density: max. 10 mA/cm^2
- Beam current: 7 - 80 µA
- Beam diameter: 750 - 1200 µm (FWHM)
- Milling rate: 28 µm/h on c-Si at 2 keV ion energy and 30° angle of beam incidence

SPECIMEN STAGE

- Milling angle: 0° - 30°, electronically adjustable in 0.1° increments
- Computer controlled in-plane specimen rotation and oscillation (0° - 120° angular range, electronically adjustable in 10° increments)
- Remarkable thickness range of the accepted TEM samples (30 - 200 µm)

POWER REQUIREMENTS

- 100 - 120 V / 10 A / 50-60 Hz or
- 220 - 240 V / 5 A / 50-60 Hz

IMAGING SYSTEM

- CMOS camera image for full visual control and milling supervision/termination
- High-resolution (5 Mpixel) color CMOS camera
- Manual zoom video lens of 50 - 400× magnification range

COMPUTER CONTROL

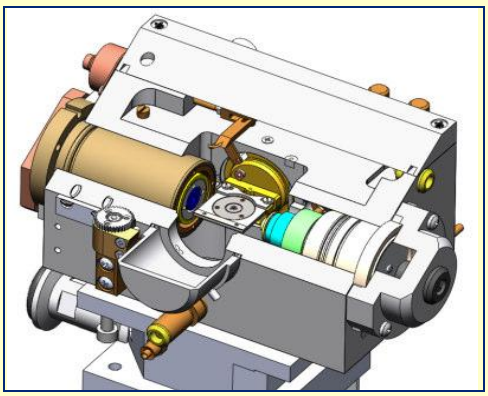
- Built-in industrial grade PC
- Easy-to-use graphical interface and image analysis module
- User-independent ion source setup including gas flow regulation by motorized needle valve
- Pre-programmed milling recipes for automatic setting of mechanical and electronic milling parameters (manual adjustment is also possible)
- Automated sample loading
- Automatic termination: by timer or optical termination of the milling process supported by an image analysis module detecting the sample perforation or monitoring the evolution of surface topography

GAS SUPPLY SYSTEM

- 99.999% purity argon gas of 1.3 - 1.7 bar absolute pressure
- Dedicated pressure regulator for noble gas service with electronic outlet pressure monitoring
- High-precision working gas flow control via motorized needle valve

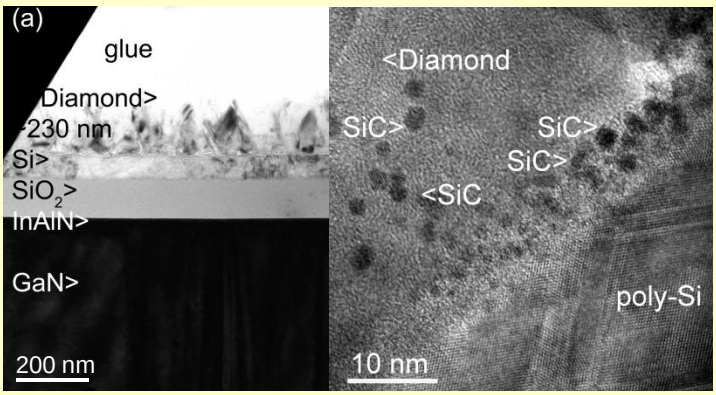
VACUUM SYSTEM

- Pfeiffer vacuum system with oil-free diaphragm and turbomolecular pumps equipped with compact, full-range Pirani/Penning vacuum gauge



IV7 vacuum chamber with two ion guns

TEM images of diamond layer grown over InAlN/GaN HEMT structure



Cross-sectional bright field image of the HEMT structure covered by SiO, Si and diamond layers

High resolution TEM image showing a transition zone between the Si layer and the diamond field with cubic SiC grains

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