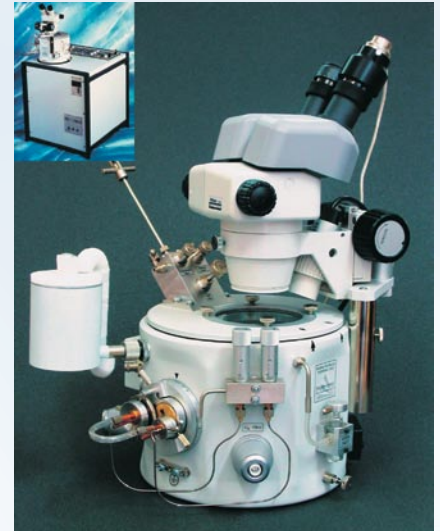


# IV3-IV4 Ion Mills

- Multiple ion sources
- High milling rates and final polishing capability in one equipment
- Unique retarding field operation
- Optional reactive ion milling, liquid nitrogen cooling and ion beam slope cutting



The IV3 and IV4 ion mills of Technoorg Linda were developed for high quality sample preparation of materials with special preparation requirements. The design of the ion mills allows free variation of ion source parameters, and provides a large variety of ion source combinations. Specific setups enable rapid ion milling and final polishing within the same chamber without removing the specimen. Our ion mills are recommended to users developing new materials, new sample preparation methods and who want to have full control of the sample preparation process.

## ION SOURCES

The basic configuration of IV3 and IV4 utilizes 2 independent water-cooled high-energy ion sources (operation range: 2 to 10 keV) that are independently controlled. The unique design of the gun mounts makes possible to maneuver the guns in vacuum and set any milling angle from 0 to 90 degrees providing ultimate flexibility and possibility of low-angle shadow-free ion beam thinning. The dual beam modulation system of IV3 and IV4 enables simultaneous thinning of both sample sides at different accelerating voltages. The beam modulation with beams off during 1/2 of a rotation or the rocking maneuver reduces sample heating for heat sensitive materials. Visual alignment of the beam is assisted by fluorescent characteristics of the Ti specimen holder. Ion sources in the basic configuration of IV3 and IV4 are water-cooled TELETWIN ion guns operating at 2-10 keV with Ar<sup>+</sup> ions. Optionally these ion sources can be replaced with one focused high-energy ion gun (2 to 10 keV) to achieve high (>350 μm/h) thinning rates or a low-energy hot-cathode focused ion gun (100 to 2000 eV), which guarantees clean specimen surfaces without

amorphization. All combinations of ion sources are available for both IV3 and IV4.

## SPECIMEN EXCHANGE

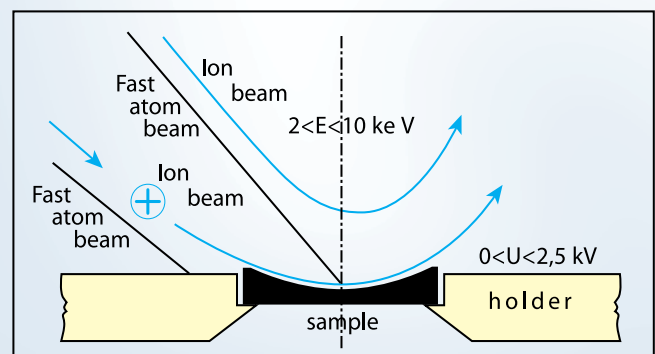
IV4 is equipped with an air-lock sample exchange system that guarantees a clean milling environment, minimizes sample contamination and supports high-throughput applications.

## LARGE TRANSPARENT REGIONS

The exclusive design of IV3 and IV4 permits the preparation of extremely large (> 100 μm<sup>2</sup>) TEM transparent areas.

## RETARDING FIELD

The retarding field operation is a standard feature of IV3 and IV4. This extension was developed to eliminate preferred sputtering and ion shadowing at low-angle bombardment. The incident ion beam is bent over the sample surface with a retarding field ranging from 0 to 2.5 keV. This method also eliminates preferred etching due to the grazing incidence.



OPTIONAL REACTIVE ION MILLING, LIQUID NITROGEN COOLING AND ION BEAM SLOPE CUTTING  
Several optional features are available for IV3 and IV4 in order to broaden the range of materials that could be prepared in our ion mills. Chemically assisted ion bombardment significantly reduces preferred sputtering. In compound semiconductors like GaAs the Ar<sup>+</sup> milling also produces artifacts. IV3 and IV4 utilize iodine as chemically active ions for artifact-free preparation.

Standard sample holders for IV3 and IV4 can be equipped with liquid nitrogen cooling. This feature reduces excessive sample heating during the low-angle ion bombardment. Thus, heat-sensitive materials can be prepared without destabilization of internal structures. IV3 and IV4 can also be used for ion beam slope cutting for SEM applications with Hauffe sample holders. Samples of up to 5 mm thickness can be cut in the ion mills.

#### ION SOURCE

Standard configuration:

*2 water-cooled TELETWIN ion guns*

- Variable, manually adjustable ion energy (2 to 10 keV)
- Variable, manually adjustable ion current
- Highest thinning rate (Si/30°): 200 µm/h

Options:

*Focused high-energy ion gun*

- Highest thinning rate (Si/30°): 350 µm/h

*Focused low-energy ion gun*

- variable, continuously adjustable ion energy (100–2000 eV)
- variable, continuously adjustable ion current (7–90 µA)
- Highest thinning rate (Si/30°): 28 µm/h

#### SPECIMEN ADJUSTMENT

*Standard configuration, two sample holders supplied - one for single side, one for double side polishing:*

- Cu sample holders (Ø20 mm) with Ti cog-wheels
- Sample rotation speed: 3 to 5 rpm
- Sample oscillation angle: ± 0° to 90°
- Sample tilting: 0° to 90°
- Angle of incidence:
  - Standard double-sided sample holder: minimum 3°
  - Single-sided sample holder: 0° to 90°

*Hauffe-sample holder (optional):*

- Designed for ion beam slope cutting for SEM applications

#### RETARDING FIELD

- Retarding voltage: 0 to 2.5 kV
- Maximum current of the retarding source: 1 mA

GAS SUPPLY (Ar): < 1 cm<sup>3</sup>/min

#### OPTICAL TERMINATION

- Minimum perforation diameter for thinning termination (nontransparent materials, metals): < 40 nm
- Minimum sample thickness for thinning termination for Si without perforation: < 100 nm

#### VACUUM SYSTEM

- Pfeiffer vacuum system with oil-free membrane and turbomolecular vacuum pumps, equipped with compact full range gauge (operating with Pirani and Penning heads)
- Load-lock sample exchange system (for IV4)

#### SPECIMEN OBSERVATION

- NIKON SMZ 660 stereoptical microscope with transmitted and reflected illumination: continuously variable magnification with 8–50× zoom objective
- High-performance stereoptical microscope (optional)
- CCD camera based visual control system including a video lens, color CCD camera, camera support and 15" TFT monitor (optional)

#### COOLING STAGE (OPTIONAL)

- Liquid nitrogen cooled stage for heat-sensitive materials (available for all standard specimen holders)

REACTIVE ION MILLING (optional): iodine source

#### SIZE / WEIGHT

Vacuum chamber

- width: 190 mm, height: 225 mm
- weight: ca. 7 kg (15.6 lbs)

Power supply unit

- width: 450 mm, height: 267 mm, depth: 305 mm
- weight: 17 kg

#### POWER REQUIREMENTS

- 100–120 V / 2.0 A / 60 Hz or 220–240 V / 1.0 A / 50 Hz
- single phase

COOLING WATER REQUIREMENT: 0.5 l/min