Gentle Mill 3

A unique sample preparation process for electron microscopy...

just a click away...
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Ion beam workstation for preparing highest quality TEM/FIB samples

- Fast, reliable method for cleaning and post-processing of TEM and FIB samples
- User-independent, automated operation with pre-programmed recipes
- Special model for direct application of 3D sample holder of Hitachi's FIB-STEM/TEM systems

The Gentle Mill series of Technoorg Linda has been designed for final polishing, easy cleaning and improving the quality of samples previously treated in standard high-energy ion mills or FIB columns. Gentle Mill models are recommended to users who want to prepare ***artifact-*** and ***damage-free*** XTEM, HRTEM or STEM samples of the best possible quality.

The Gentle Mill 3 is also suitable for quick thinning of dimpled or thin (<25µm), planar, mechanically polished samples.

State-of-the-art low-energy Ion source

The Gentle Mill 3 ion beam workstations operate with a patented hot-cathode low-energy ion source. The extremely low energy of the ion beam guarantees minimization of surface damage and ion beam induced amorphization. The exceptional construction of the ion source allows high ion beam current densities. All ion gun parameters including accelerating voltage and cathode current are controlled automatically by a digital feedback loop, and can always be changed manually during the sample preparation procedure. The initial values of the ion source parameters are set either automatically or manually and are continuously displayed on the computer screen.

Artifact-free sample preparation

The Gentle Mill 3 is capable of producing damage-free samples with low-energy ion bombardment and provides unique opportunities to study the real nanostructures in synthesized and natural materials in all fields of technical and material science research.

Automated Operation

The third generation Gentle Mill model is provided with full computer control utilizing an easy-to-use graphical interface. All milling parameters including ion source setup, gas flow control, sample motion, tilt angle, and perforation detection can be stored or pre-programmed in the system. This fully automated feature enables production of high-quality samples with minimal user intervention. The Gentle Mill 3 is supplied with a software extension for on-line support, which enables error detection and diagnosis with Technoorg Linda Technical Staff.

Special Models for Direct Application with Hitachi's FIB/STEM Systems

Hitachi and Technoorg Linda offer a complete solution for site-specific and low-damage specimen preparation based on Hitachi's FIB/STEM systems and the Technoorg Linda Gentle Mill 3 ion beam workstations. The low-energy ion milling and cleaning capability of the fully automated Gentle Mill 3 models is used in the final stage of FIB specimen preparation to remove the amorphized or otherwise damaged surface layers. These models allow direct insertion of Hitachi's 3D FIB/STEM sample holders, and drastically decrease sample preparation time.

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Gentle Mill 3 Specifications

Low-Energy Ion Source (patented hot-cathode low-energy ion gun)

- Ion energy: 100-2000 eV, continuously adjusted
- Ion current density: Max. 10 mA/cm2 peak
- Beam current: 7–90 μA, continuously adjustable
- Beam diameter: 750–1200 μm (FWHM)
- Manually or electronically optimized working gas flow
- 28 μm/h milling rate on c-Si at 2000 eV ion energy and 30° angle of beam incidence

Specimen Stage

- Milling angle: 0°–45°, electronically adjustable in 0.1° increments
- Computer controlled in-plane specimen rotation and oscillation (0°–120° angular range, electronically adjustable in 10° increments)
- Specially designed holder can accept TEM samples of thickness 30 to 200 μm

Specimen Handling

- Vacuum load-lock system for fast specimen exchange
- Fully mechanical, glueless specimen loading system
- Specially designed titanium frames and encapsulation technology for XTEM samples

Vacuum System

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

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

Imaging System

- CCD camera image for full visual control and milling supervision/termination
- High-resolution color CCD camera
- Manual zoom video lens of 50–400X magnification range

Computer Control

- Built-in industrial grade PC
- Easy-to-use graphical interface and image analysis module
- Easy control of all important parameters by mouse or keyboard
- Highly automated operating regime for minimal user intervention
- Pre-programmed or manually set milling and polishing cycles
- Automated termination: optical termination of the milling process supported by an image analysis module (detecting the sample perforation or monitoring the surface topography)

Gentle Mill 3 Dimensions and utilities

Size: 93cm(l) x 74cm(w) x 65cm(h) including the TFT monitor

Weight: 60kg

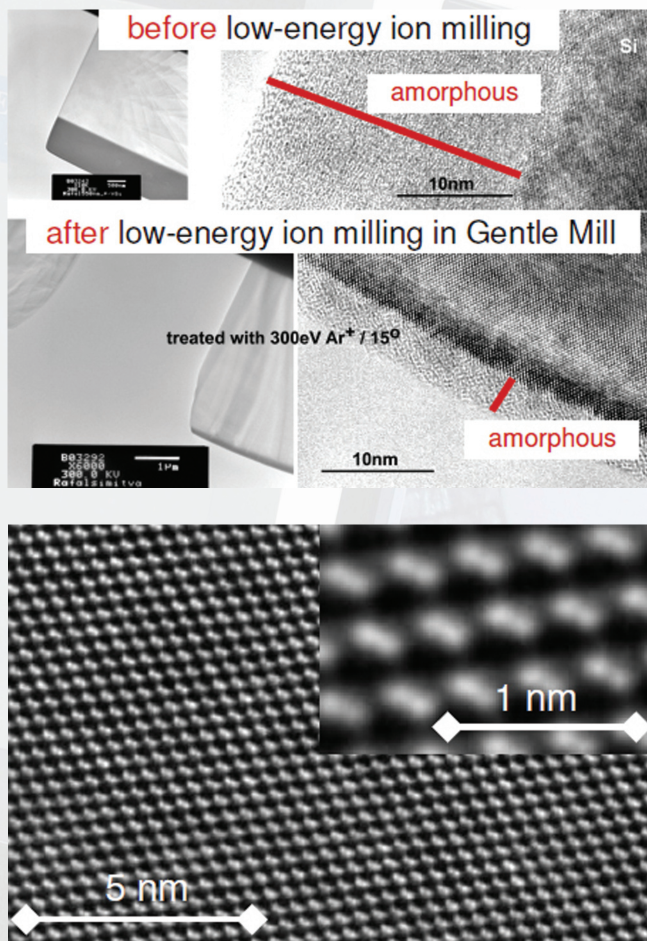
Power requirement: 100-120V/3A/60Hz or 220-240V/1.5A/50Hz

Power consumption: 500W during operation and 250W with ion source switched off

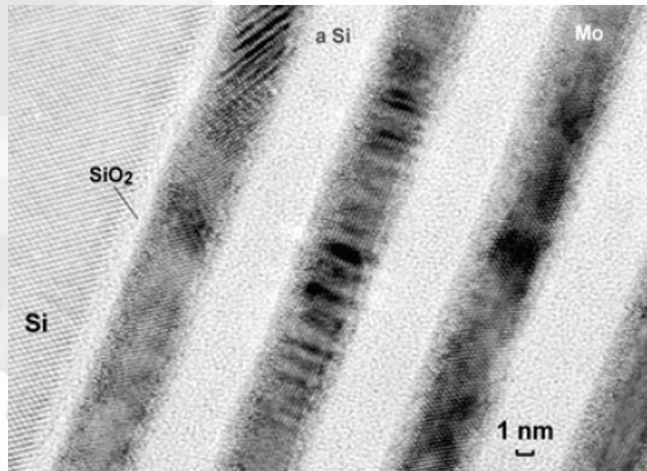
Water: 1.5 liters of ion-exchanged or distilled water for the closed-circuit cooling system

Hitachi-compatible models for direct application of 3D sample holders of Hitachi's FIB-STEM systems

TECHNOORG LINDA



Dumbbells in Si {110}. Sample was thinned by Ar+ ion milling using Gentle Mill at 200 eV ion energy and 3° angle of beam incidence. Images by courtesy of National Center for Electron Microscopy, Lawrence Berkeley Laboratories.



Cross section of a Mo/a=Si superlattice structure cleaned for 15 min/side at 250 eV ion energy, 10μA beam current and 7° angle of beam incidence