

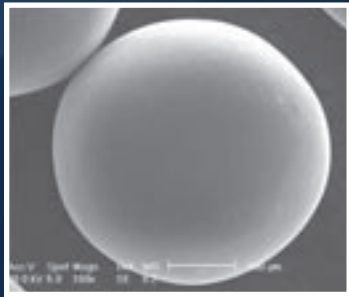
XuM

X-ray ultraMicroscopy in the SEM

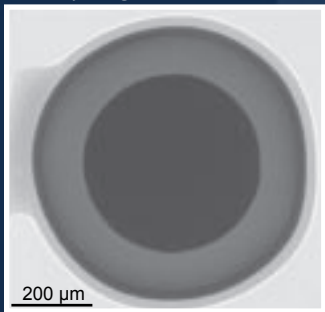
Image below the surface and add another dimension to microscopy using the SEM

- REVEAL INTERNAL STRUCTURE
- HIGH RESOLUTION
- PHASE AND ABSORPTION CONTRAST
- 3D MICRO-TOMOGRAPHY

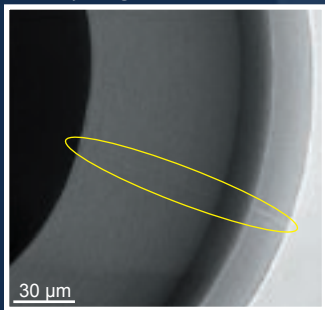
Secondary Electron Image in SEM



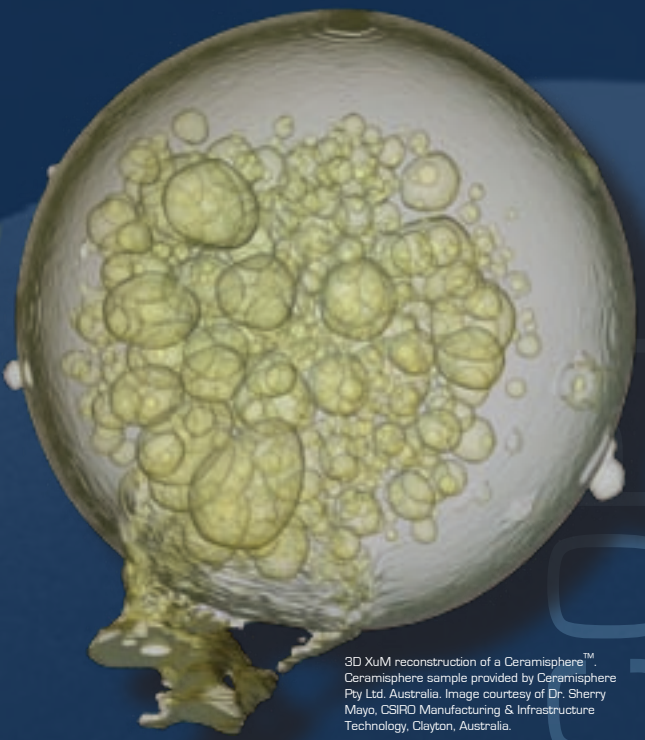
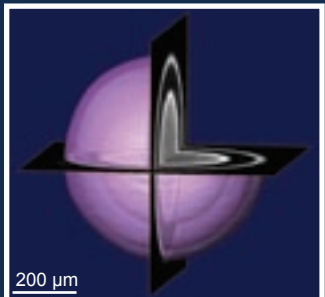
2D X-ray Image in XuM



2D X-ray Image in XuM



3D XuM Reconstruction



3D XuM reconstruction of a Cerasphere™ Cerasphere sample provided by Cerasphere Pty Ltd, Australia. Image courtesy of Dr. Sherry Mayo, CSIRO Manufacturing & Infrastructure Technology, Clayton, Australia.

XuM, the x-ray ultraMicroscope

The XuM is an SEM-hosted high resolution x-ray microscope which provides an internal view of the structure of samples without cross-sectioning. Providing 2D, stereo and full 3D tomographic imaging, the XuM adds the third dimension to scanning electron microscopy.

REVEAL INTERNAL STRUCTURE The XuM allows the scientist or engineer to investigate the inner world of their samples quickly and easily without destructive cross-sectioning or complex sample preparation. This is particularly important where the sample is valuable (and so not amenable to destructive preparation), where sectioning or invasive preparation would damage the structure or where the preparation process would be difficult, expensive or time consuming.

SEM HOSTED The XuM is an SEM hosted x-ray microscope. A point-like x-ray source is formed by focusing the electron beam onto a suitable target. The resultant x-rays are transmitted through the sample and projected onto a high resolution, high sensitivity x-ray camera to form an image. When not being used for XuM imaging, the target module is retracted to allow full use of the SEM in its normal imaging configuration.

HIGH RESOLUTION Target technology is central to the performance of the XuM. High stability targets of different geometry and composition are selected according to the imaging needs of the application. Depending upon the SEM host, XuM image resolutions of 250 nm and below are achievable.

3D MICROTOMOGRAPHY 3 Dimensional solid models of samples can be reconstructed from rotational datasets using x-ray microtomography reconstruction algorithms. This allows the arrangement of internal structures to be analyzed by "virtual slicing" without ever having to physically dissect the sample.

X-RAY PHASE AND ABSORPTION CONTRAST X-ray images generated using the XuM contain both absorption and phase contrast revealing fine edge structure and edge definition in a wide range of sample materials. Phase contrast is a phenomenon that exploits the wave properties of x-rays. It arises from the refraction (rather than absorption) of x-rays as they interact with the sample and is strongest at sharp edges, boundaries and cracks. Variations in phase contrast can occur in samples that present very little variation in density and hence show poor absorption contrast. This allows samples such as polymers and low density composites to be imaged in detail using the XuM.

Images: SEM and XuM imaging of an intact multi-layered micro sphere. From Top to Bottom: Conventional secondary electron image; 2D XuM image showing composite internal structure; 2D XuM image magnified highlighting fracture showing the complementary nature of phase and absorption contrast; 3D XuM tomographic reconstruction with cutaway section to expose internal core.



SPECIFICATIONS

PERFORMANCE

2D image resolution	100 - 250nm [SEM host dependant]
3D image resolution	250 - 1000nm [SEM host dependant]
Magnification range at CCD	10x to 3000x [SEM host dependant]
Viewable sample area	Approx 50mm x 10mm, [SEM host dependant]

TARGET POSITIONER

Attachment	According to chamber port configuration of host SEM
Target movement	Three axes (x,y,z) high precision piezoelectric nanomotors
Range of movement	18mm [all axes]
Retraction	Retractable to allow normal SEM functions
Multi-target holder	Allows up to five targets to be fitted
Targets	Range of bulk and specialized geometry targets supplied
Target current measurement	Picoammeter supplied
Accessories	Target loading tool, multi-target storage box supplied

X-RAY CAMERA

Attachment	According to chamber port configuration of host SEM
Detection method	Direct detection, front illuminated, deep depleted, protected by Be vacuum window
CCD active area	26.8mm x 26mm
CCD array	1340 x 1300 pixels
Optimum x-ray energy range	4 - 12 keV
Modes of operation	High resolution mode / survey mode
Image acquisition times	High resolution imaging: 1-100s per frame with multi frame averaging / summation Survey mode: 1-10s per frame [refresh mode]
Binning	x1, x2, x4, x8
Dynamic range	16 bit digitization @ 1MHz
Operating temperature	-55°C [~20 mins cool down time from room temperature]

SAMPLE HANDLING

Sample holders	Range of large and small sample holders supplied
Accessories	Sample loading tool, sample holder stand, sample boxes
SEM stage control	Software controlled in X,Y,Z and R. Requires motor stages on SEM

CONTROL SYSTEM

Computer platform	PC with Microsoft Windows™ supplied
Software	XuM Control for instrument hardware control, image capture and display X-TRACT [option] for image analysis, phase retrieval and tomographic reconstruction

INSTALLATION UTILITIES

Power requirements	< 500W. 110 or 240 volts. 50 / 60 Hz.
Water	Required for cooling x-ray camera. Rate 1 - 3 liters/min
Average shipping weight	150 kg dependant on configuration

Gatan Inc.
Corporate Office
Western USA Sales
5933 Coronado Lane
Pleasanton, CA 94588
Tel. (925) 463 0200
Fax. (925) 463 0204
Contact: info@gatan.com

Eastern USA Sales
780 Commonwealth Drive
Warrendale, PA 15086
Tel. (724) 776 5260
Fax. (724) 776 3360
Contact: info@gatan.com

Gatan UK
25 Nuffield Way
Abingdon
Oxon, OX14 1RL
United Kingdom
Tel. +44 (0)1235 540160
Fax. +44 (0)1235 540169
Contact: ukinfo@gatan.com

Gatan GmbH
Ingolstädterstr. 12
D-80807 München
Germany
Tel. +49 89 358084-0
Fax. +49 89 358084-77
Contact: mfelsmann@gatan.com

Gatan France
3bis, Chemin du Haut Breuil
78113 GRANDCHAMP
FRANCE
Tel: +33 1 34944407
GSM: +33 6 80135139
Fax: +33 1 34871668
Contact: dmonville@gatan.com

Gatan Singapore
10 Eunos Road 8
#12-06 Singapore Post Centre
Singapore 408600
Tel: (65) 6293 3160
Fax: (65) 6293 3307
Contact: wchuang@gatan.com

Gatan On-line
<http://www.gatan.com>
info@gatan.com

ORDERING INFORMATION

Please contact your Gatan sales representative for complete ordering information.

MODEL NUMBER	DESCRIPTION
500.A	Complete advanced XuM package including both 2D x-ray imaging and 3D x-ray tomography capability.
500.T	2-day installation and basic training on-site.
500.TT	Extra day of basic operator training
500.TA	1-day advanced application training on-site
500.TA2	2-day advanced application training on-site
500.TS	Advanced user training school covering various aspects of XuM operation and theory
Software Option	
702.00	3D Visualization and Analysis software

Phase contrast technology by XRT

This publication is the copyright of Gatan Inc. and contains information which may not be used or reproduced unless agreed by the company in writing. Gatan Inc. has a policy of continued improvement. The company reserves the right to alter, without notice, the specification, design or conditions of supply of any product or service. XuM is a registered trademark of Gatan Inc. © Gatan Inc. 2006. All rights reserved.



www.gatan.com