

Update on the optics fabrication and metrology (OFM) group capabilities

Albert Macrander, XFD

Outline:

Group members/service capabilities

Review committee report

Response activities

**Update on capabilities/Recent optics
examples**

Argonne National Laboratory



Office of Science
U.S. Department of Energy

A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago



OFM Group

<http://www.aps.anl.gov/xfd/optics/>

Albert Macrander, Group Leader

Tel. 630-252-5672 macrander@aps.anl.gov

Janet Werner, Secretary

Tel. 630-252-9896 werner@aps.anl.gov

Fax: 630-252-9303

Lahsen Assoufid, Metrology Captain

Tel. 630-252-2774 assoufid@aps.anl.gov

Jun Qian, Metrology

Tel. 630-252-5874

Ruben Khachatryan, Fabrication Captain

Tel. 630-252-9395 khachat@aps.anl.gov

Chian Liu, Deposition Captain

Tel. 630-252-9985 cliu@aps.anl.gov

Ray Conley, Deposition

Tel. 630-252-8733 rconley@aps.anl.gov

S. (Felix) Krasnicki, Topography Captain

Tel. 630-252-9186 krasnick@aps.anl.gov

Josef Maj, Topography

Tel. 630-252-9142

Ali Kousary, Mirror Design Captain

Tel. 630-252-3384 amk@aps.anl.gov

**Advanced
Photon
Source**



OFM Review Committee

Dr. Peter Z. Takacs
Instrumentation Division
Brookhaven National Laboratory

Dr. Thomas Gog
CMC-CAT, APS-XFD
Advanced Photon Source
Argonne National Laboratory

Dr. Ivan N. Nesch
Department of Biological, Chemical & Physical Sciences
Illinois Institute of Technology

Dr. D. Peter Siddons
National Synchrotron Light Source
Brookhaven National Laboratory

Dr. James Underwood
Oakland, CA

Report of the Committee

Review of APS Optics Fabrication and Metrology Group on 25 April 2003 at Argonne National Laboratory

Charge to the Committee:

Assess the current capabilities of the Optics Fabrication and Metrology Group, comment on the relevance of those capabilities, and provide advice on the future directions of this Group to the APS management.

Specific questions to address:

- How do our capabilities compare to other facilities?
- Are we providing the correct services to users?
- Are we appropriately staffed?
- Are the present resources (staff and money) appropriately distributed within the group?
- What do we need to invest in now?
- What areas do we need to invest in over the next several years to ensure we are at the state-of-the-art in the next 5 to 10 years so that our efforts will provide the highest scientific payoffs?

Advanced
Photon
Source

ARGONNE NATIONAL LABORATORY



Report and Recommendations of the Committee

The Committee was duly impressed with the high quality, well-equipped complex of facilities available for the support of users and staff at the APS. The capabilities of the OFM Group appear to be at least as good and, in some cases, are considerably better than at comparable facilities at other places around the world.

The two primary functions of the OFM Group appear to be:

- I) Service to users,***
- II) Research and Development efforts***

Service to users

The service function is to provide to the user community

- proto-type fabrication of x-ray optical components (mirrors, crystals, multilayers)
- metrological (mechanical) and x-ray characterization of such components
- liaison to commercial companies manufacturing relevant components

These efforts can be divided into the following four areas:

- X-ray crystal fabrication, cutting and mounting.
- X-ray crystal topography/vonLaue characterization.
- Mirror metrology.
- Education and liaison between the APS staff, users, and industry

The committee feels that providing these services is essential to the success of the user experimental program at the APS in the sense that optical components need to be properly tested and characterized ex-situ before installation on an x-ray beamline.

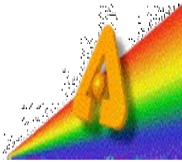
- One observation of the committee is that the general APS user may not be adequately informed about the services provided by the OFM.
- The committee feels that more information as to the capabilities and services provided by the OFM group should be made available to the user community. This could be accomplished by an updated web site listing the machines and services available, ...
- Presently, users request work through the submission of a Work Request Form for the various facilities in the OML group. The committee finds this to be an extremely useful process that could be further enhanced by making use of web-access for form submittal and tracking. ...
- Long-term planning involves upgrading or updating major instruments and machines....
- An important function of the APS staff is to provide educational opportunities to inexperienced staff and users regarding the specialized services available to the community. ...
- One critical staffing issue that was identified (and that is currently being addressed by APS management) was the need to have an additional staff person to assist Ruben Khachatryan in the Optics Fabrication Lab. He needs to train an assistant in fabrication techniques for crystal materials so that there is continuity should he not be available.

Research and Development efforts

Most of the R&D efforts of the staff of the OFM are aligned toward improving the performance of user and staff beam lines. The committee finds that this is a good use of facility resources. It is important that the staff of a predominantly service-oriented organization be encouraged to pursue independent research and collaborations with other organizations. This is an important investment for the future that will provide useful techniques and instrumentation for future projects. ...

Concerning specific R&D projects :

- There was consensus that “stitching” as a means to enhance mirror metrology is a very worthwhile project that should be pursued vigorously.
- On the other hand, developing “super-smooth” polishing techniques is probably best left to manufacturers that provide commercial products. ...
- A major discussion topic among the committee concerned the machines in the coating lab. Owing to the significant interest in multilayer coatings on moderately-sized substrates for various applications, the committee recommends that an additional small coating chamber be acquired. This would provide additional support for the variable-thickness coating development program for KB mirror fabrication, among other uses. ...
- The review committee noted the usefulness of the OFM group identifying and exploring industrial efforts relevant to the fabrication of x-ray optical components and appreciated attempts to collaborate with commercial companies in this regard.



**Experimental Facilities
Division**

**Welcome to the Homepage
of the
Optics Fabrication & Metrology
Group**

Mission

The Optics Fabrication & Metrology Group (OFM) is part of the Experimental Facilities Division at the Advanced Photon Source, Argonne National Laboratory (Illinois, USA).

Our mission is:

- 1. to operate and develop instruments to fabricate and characterize x-ray optical elements, such as single crystal-monochromators, mirrors, multilayers, and other special substrates;**
- 2. to carry out joint programs with the user community on the development of new optics for special beamline applications.**

The mission is carried out in a collaboration with scientists and engineers and users at the APS, and others in industry, academia, government, and other synchrotron sources in the world.

- Staff**
- Capabilities**
- Deposition Lab.**
- Group Publications**
- Metrology Lab.**
- Labs.**
- Publications**
- Submit a**
- [Work-Request Form](#)**
- X-Ray Optics Design & Development**
- Other R&D Activities**

Report website problems to: werner@aps.anl.gov

Last update : December 3, 2003

Optics Work Request System - Submit

[Logout](#) | [Main Menu](#) | [Query Request](#) | [Modify Request](#) |

Work Request Number: To be assigned

Record # 1

Name: MACRANDER, ALBERT T.

Badge No: 20241

Email: atm@aps.anl.gov

Phone No: 2-5672

Fax No: 2-9303

Type of Work:

- Deposition of thin films Fabrication of Crystals Metrology
 X-ray Characterization Optics Development

Beamline:

---Select Beamline---

Priority:

- Urgent As Time Permits

Work Title:
(80 characters max.)

Safety Concerns:

- Yes No If yes, please indicate below

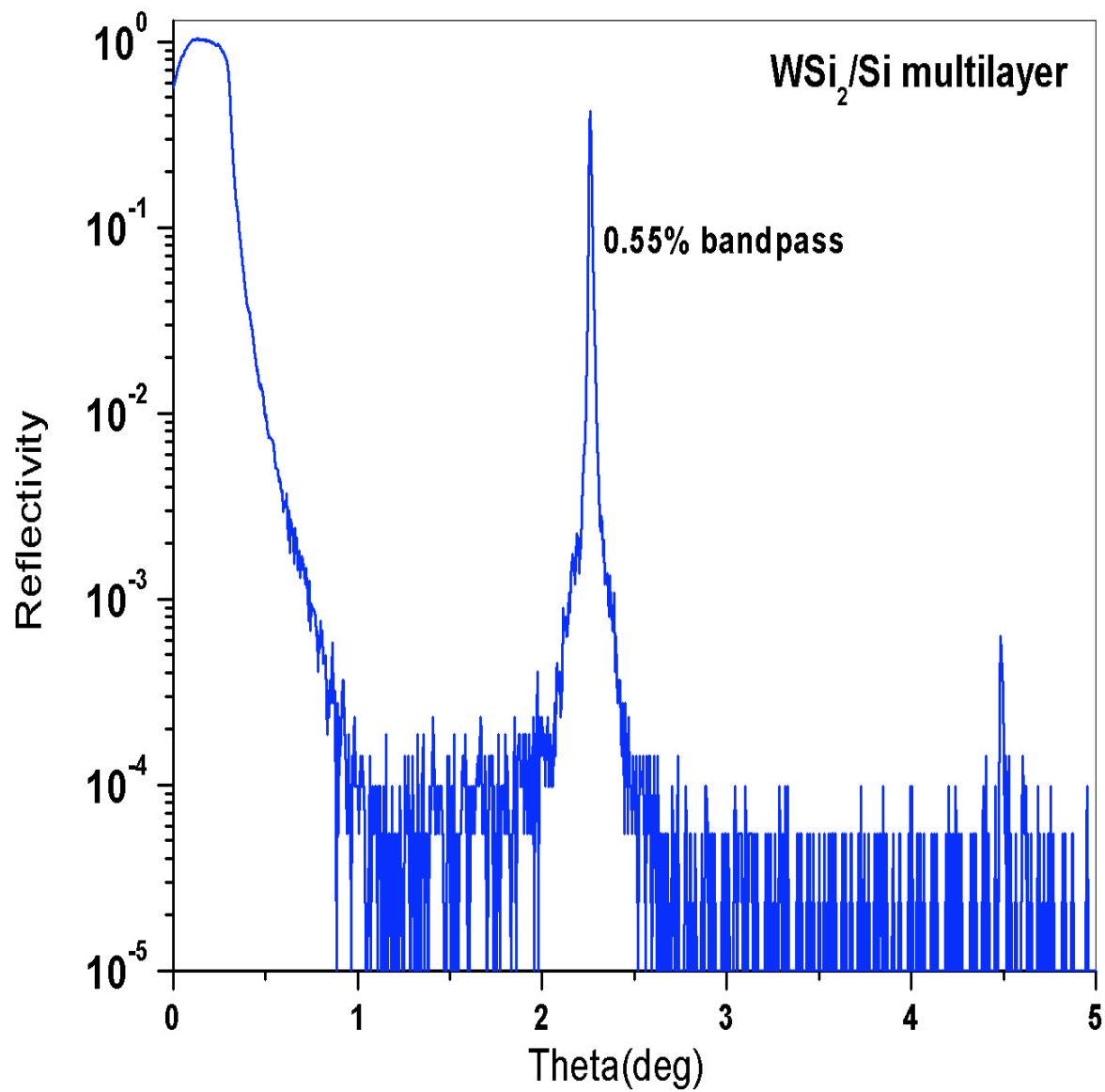
(400 characters max.)

Next

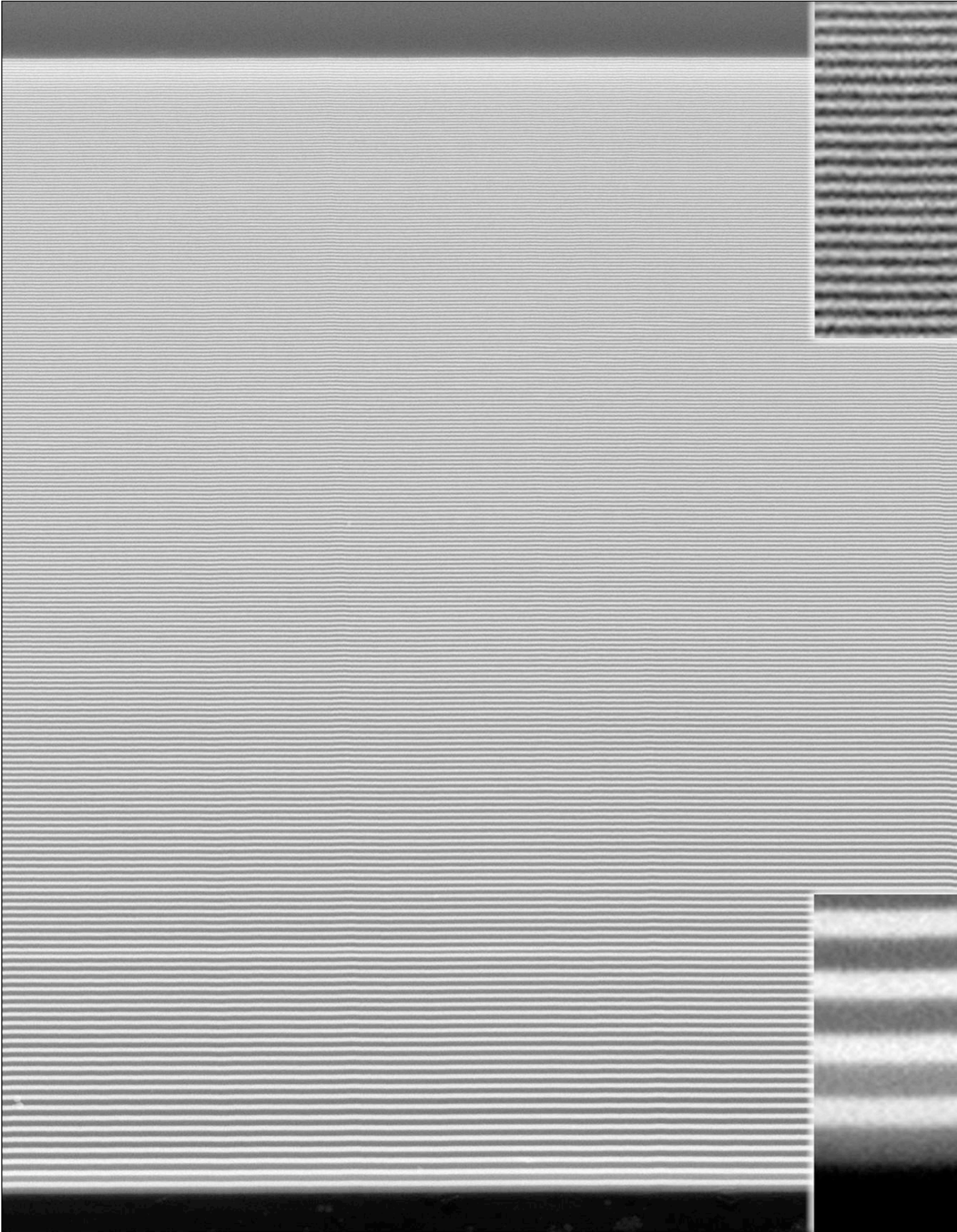
Clear

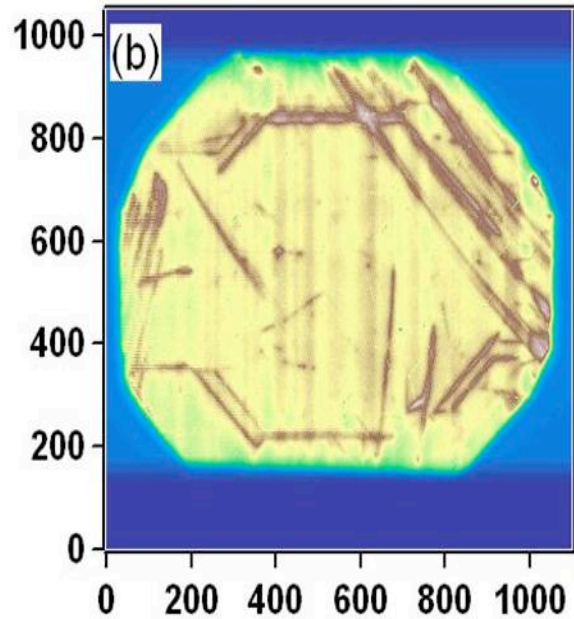
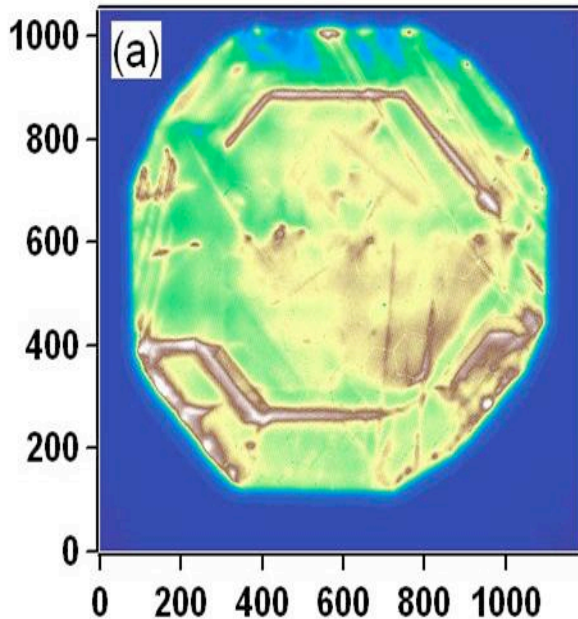
[Logout](#) | [Main Menu](#) | [Query Request](#) | [Modify Request](#) |

Argonne National Laboratory
ofmwrq_entry_pkg 20031212.1



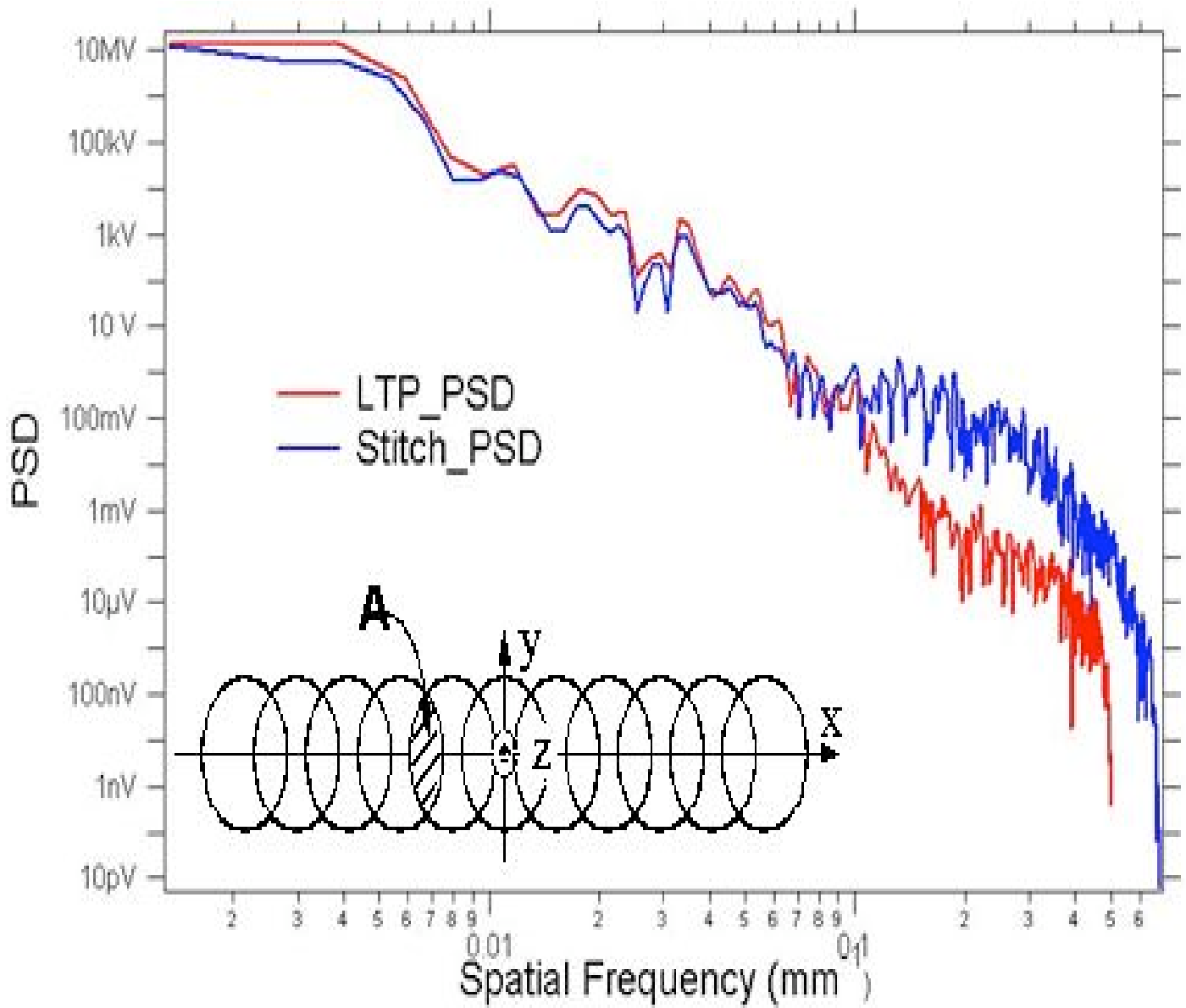
469-layer linear zone plate, 15.0nm - 59.7nm, 36hr growth time



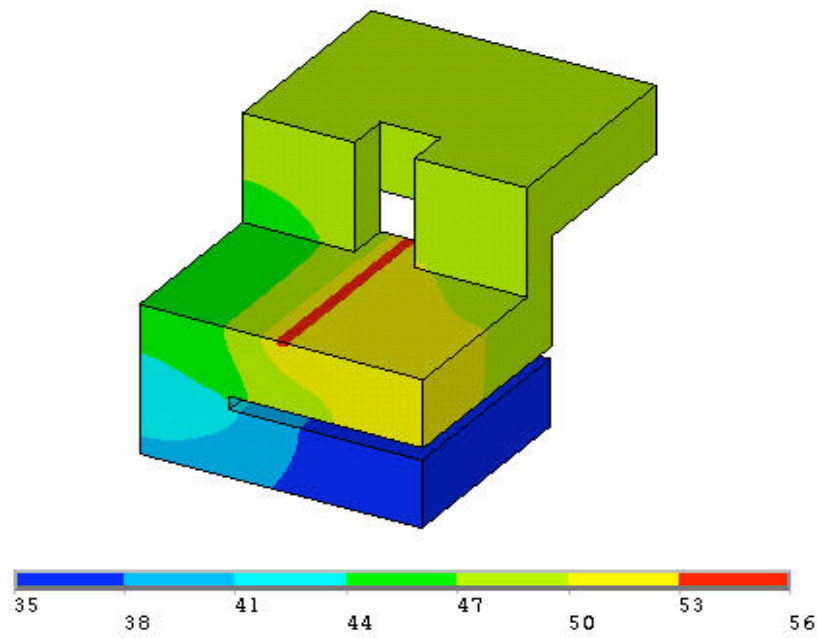


(a) A (224) topographic image with the entire sample illuminated at once of a (001) oriented diamond plate at 12.0 keV with a two-theta angle of 90 deg.

(b) A tomographically depth limited topography image for the same diamond under the same diffraction conditions where the depth is limited to ~25 microns below the surface. (Data for a small portion of the sample is missing near the bottom of the figure). The axes units are CCD pixel numbers; the diamond was 6 mm x 4 mm in area with a thickness of 0.5 mm.



Z-shaped channel-cut monochromator



Temperature (°C)

Summary of Responses to the review:

- Improved web based information
- Web based work request system

(A brochure is also being prepared)

Open for business for users (“Cost free”):

- Metrology
- Sputtered films and multilayers
- Crystal Fabrication
- Topography
- Mirror design

Acknowledgements:

Michael Bray, stitching

Yaming Li, Kristina Young, students

Yong Chu, A. Tkachuk, 2-BM

Hyon Chol Kang , Brian Stephenson, Jorg Maser, MLL

(also, Leo Ocola, M. Zurbruchen, S. Streiffer- Raithe SEM)

Yuncheng Zhong, topographic tomography