X-ray and Neutron Optics
COST Action P7 Progress Report

Annual report 2003

History of Organization

- Initiator and first organizer of the network:
  Dr. Pierre Dhez, LURE Orsay.
- Start Date: 15 April 2002, Brussels
- Number of signatories: 11
  Belgium (24/01/2002), Czech Republic (17/01/2002), France (31/01/2002), Germany (17/01/2002), Netherlands (17/01/2002), Spain (17/01/2002), United Kingdom (17/01/2002)
  Italy (12/03/2002) Sweden (27/03/2002)
  Slovakia (22/05/2002) Hungary (15/07/2002)
- Non-COST members:
  Russian Academy of Sciences, Rostov State University.

Objectives

- The main objective of the Action is to increase the knowledge in the field of X-Ray and Neutron interactions with solid surfaces and interfaces, develop fabrication and characterization methods for advanced innovative optical elements for applications in this extreme short wavelength range.

Goals

- Increase the knowledge in the field of X-ray and Neutron Optics, which is necessary to develop new type of optical elements adapted to this energy range, as well as to improve the efficiency and versatility of those optics.
- Extend the field of applications of very short wavelength optical elements on current x-ray and neutron sources. Test the new fields now foreseen due to better characteristics of the more recent and of the planned new sources.
- Reinforce the interactions and the cooperation between the different national groups of designers and users of x-ray and neutron optics.

Participating institutions

Large-scale EC X-Ray and Neutron Facilities.

Operating X-ray Facilities:

ESRF Grenoble (F), LURE Orsay (F), ELETTRA Trieste (I), BESSY Berlin (DE), SRL Daresbury (UK), MAXLAB, Lund (S)

Operating Neutron facilities:

HMI Berlin (DE), ILL Grenoble (F), CEA Saclay (F), Rez, Czech Rep.

New construction:

SOLEIL (F), DIAMOND (UK)

Developments potential

- European Universities and Research Institutions:

Belgium	University of Liège
Czech Republic	Institute of Physics, The Institute of Nuclear Physics, Academy of Sciences
Spain	Consejo Superior de Investigaciones Científicas (CSIC) de Física Aplicada
Hungary	Research Institute of Solid State Physics and Optics, Mirrotron Ltd. Multilayer Laboratory
Italy	Istituto Elettronica Stato Solido (IESS), IMEM CNR
The Netherlands	FOM Instituut AMOLF, Rijnhuizen
Slovakia	Institute of Physics, Institute of Electrical Engineering, Slovak Academy of Sciences
Russia	Institute of Microelectronics Technology RAS, Rostov University.

- Optics groups at the large facilities.

Structure and organization

- Chairman: Dr. Thomas Krist (HMI Berlin)
  Co-chairman: Dr. Mourad Idir (SOLEIL, Orsay)

- Management committee (20 participants):
- B- **Prof. J.-P. Gaspard**
- CZ- **Dr. Jaromír Hrdý, Dr. Pavol Mikula**
- D- **Dr. Thomas Krist**, **Prof. Dr. Alexei Erko**
- E- **Dr. Jose Antonio Aznárez**, **Dr. Juan Ignacio Larruquert**
- F- **Dr. Mourad Idir**, **Dr. Frédéric Ott, Dr. Francois Polack**,
- UK **Dr. Marion Bowler**
- H- **Dr. László Rosta, Dr. Rita Kovács-Mezei**
- I- **Dr. Stefano Lagomarsino, Dr. C. Ferrari**
- NL- **Dr. Jan Verhoeven, Dr. F. Bijkerk**
- S - **Dr. Ralf Nyholm**
- SK- **Dr. Dusan Korytar, Dr. Matej Jergel**

History of implementation

- First MC meeting: 15 April 2002, Brussels
  Chairman: **Dr. Idir Mourad (LURE)**
  Vice-Chairman: **Dr. Thomas Krist (HMI)**
- Four Working Groups
- Established the Website of the Action
- BESSY GmbH as contact person for STSMs.
  Prof. Alexei Erko

Working groups

- WG1 : Theoretical calculations. Modelling.
- WG2 : Surface preparation and tests for reflective optics.
- WG3 : Fabrication and test of interferential mirrors.
- WG4 : Fabrication and test of diffractive and refractive optics.

1st working groups meeting.

- First WG "kick-off" meeting, September 6, 2002
- Participation: 32 scientists and experts from 10 EU countries , Representatives from two large industrial companies: SESO and Jobin Yvon
- 16 oral presentations
- Chosen some topics of a mutual interests for the working groups.

Common topics for the working groups (after 1st WG Meeting)

- WG1
  - Ray-tracing of the diffraction optical components.
  - Modelling of wavefront propagation.

- WG2
  - Surface Long-Trace-Profiler (LTP) measurements with advances accuracy.

- WG3
  - Influence of stress in the multilayer systems on reflection properties and methods of its reduction.

- WG4
  - Diffraction-refraction crystal optics, refractive planar lenses.
  - Curved crystal optics.

Short term Scientific Missions 2003

- The main goal: independent support for the scientific cooperation between groups in different countries.
- Scientific evaluation of each mission by the representatives of all four WGs.
- Fast and qualified administrative procedure in the STSM responsible Institution.

Action P7 STSM politics

- The support of “optics-development” institutions to access large X-Ray, Neutron and production facilities.
- To support “risky” projects and exchange of ideas between scientists in working groups.

STSM missions overview.

- Dr. Artemiev Nicolai,
  From: Institute of Physics, Academy of Sciences of the Czech Republic.
  To: BESSY GmbH, Berlin, Germany (1-31/3/03)

  "Application of the theory for diffractive optics to the raytracing code RAY for Fresnel zone plates".
  Results: Implementation of zone plate model in the RAY raytracing code. Two joint publications in preparation.

- Dr. Marion Bowler,
  From: Daresbury Laboratory, UK
  To: BESSY GmbH, Berlin, Germany (3-7/11/03)

  "The use of the code PHASE – wave propagating code".
  Results: A beginners guide for the code. This guide is essential for everybody who will work with the code.

STSM missions overview. (Cont.)

- Dr. Alessia Cedola
  From: C.N.R. - Institute of Photonics and Nanotechnologies, Rom, Italy
  To: ESRF Grenoble, France (7-12/11/03)

  "Application of X-ray waveguide optic"
  Results: Discussion of preliminary results and future projects

- Dr. Vito Mocella
  From: CNR- IMM, Napoli, Italy
  To: ESRF Grenoble, France (1-17/12/03)

  "Focusing in Laue geometry using bent crystals"
  Results: Two article drafts have been finalized.

STSM missions overview. (Cont.)

- Dr. Vladimir Komlev

From : National Institute for the Physics of Matter, Ancona, Italy

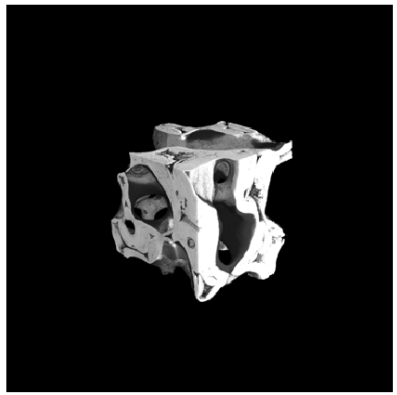
To: ESRF Grenoble, France (4/11-3/12/03)

"Synchrotron X-ray microtomography with reflecting type X-ray μ-optics".

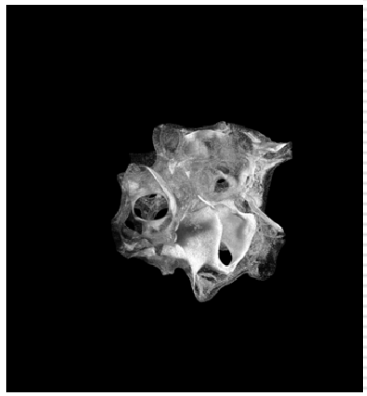
a. - 3D-detail image of ceramic scaffold with Bone Marrow Stromal Cells (BMSC) at 8 weeks implantation;

b. - 3D-section of TCP scaffold with BMSC showing newly formed bone; 5μm

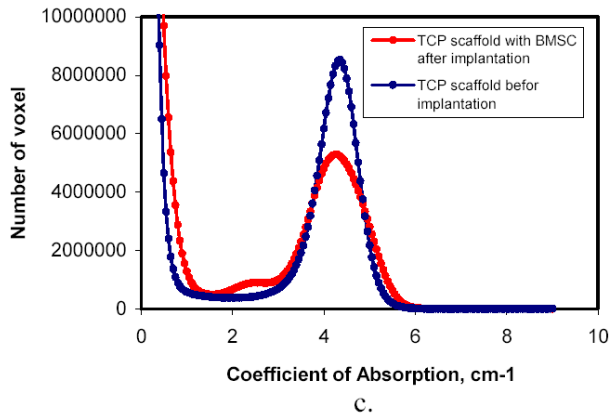
c. - Gray level histogram of the whole reconstructed volume of ceramic scaffold before and TCP scaffold with BMSC after implantation.



a.



b.



c.

STSM missions overview. (Cont.)

- Dr. Kirill Potlovskiy

  From: Institute of Physics, Academy of Sciences of the Czech Republic.

  To: ESRF, Grenoble, France (6-21/11/03)

  "Stearin Compound Refractive Lens"

  Results: First experience with stearin material as a basis for compound lenses.

- Mrs. Anke Teichert

  From: Hahn-Meitner Institute Berlin

  To: FOM Institute for Plasma Physics Rijnhuizen, The Netherlands 8-12/12/03

  „Preparation of multilayer systems with reduced stress".

  Results: Comment of the host institute: "the exchange of basic understanding was effective and showed complementary approaches, with several indications of joint future research aspects"

2d Working group meeting

- Held in Berlin 21/11/2003
- Gathered 36 participants from 8 countries
- 25 oral presentations
- Four presentations discussed joint collaborative work in frames of Action P7.
- X-Ray optics for Free-Electron Laser sources was presented.

Contacts with small industrial companies

- Polovodice a.s. Praha , Czech Republic
- Institute of Gerätebau mbH, Berlin, Germany
- Mirrotron Kft, Budapest, Hungary
- Nob neutron optics berlin GmbH, Berlin, Germany
- AXO, Dresden, Germany
- INCOATEC GmbH, Geesthacht, Germany
- Institut für Oberflächenmodifizierung e.V., Leipzig, Germany

Results

In spite of “frozen” period of COST some successful actions have been performed in years 2002/2003.

- - two working groups meetings with participation of all the cost member countries and representatives not only from the research and development institutions, but also small and large-scale industrial companies.

- - several successful cooperative activities have been done in frames of STSM,s. The results of four of them will be published jointly. Another three give a preliminary results and indications of father interests of a joint research activity.

Results (Continued)

- - COST P7 participants groups published or prepare for publishing 57 articles and reports.

- An application of a new project "NAXOS" (**N**etwork on **A**dvanced **X**-Ray **O**ptics for microimaging technique**S**) in frames of Marie Curie Research and Training Networks.

  Principal Investigator: **Dr. Stefano Lagomarsino, MC member.**

and Conclusions

- COST is a very helpful activity to establish “horizontal” cooperation links between European laboratories.
- As the result, new ideas and experimental techniques can be discussed and even checked in frames of STSMs.
- COST Activity P7 should be continued and “frozen” period in year 2003 should be compensate.

Acknowledgements

- To all my colleagues from the Management Committee, especially Chairmans of the Action:

- Dr. Mourad Idir in years 2002-2003
- Dr. Thomas Krist, presently.

Thank you for your attention!