Journal of X-Ray Science and Technology 13 (2005) 161–162
IOS Press

Guest-Editorial

Nanostructure glass technology for x-ray optics and biophotonics

Nanostructure glass technology provides the manufacturing of high precision glass products, including 3D microstructures with a few nanometers size. The products based on nanostructure glass are widely used in the following fields of science and technology: *microstructure fibers* (holey fibers, photonic crystal fibers), which present the new type of optical waveguides with the properties of special interest for many urgent problems of modern optics, laser physics, photonics, telecommunication, and biophotonics; *x-ray optics* for guiding and focusing of x-ray and other ionizing radiation; *micromechanics* – production of micro-motors and other electromechanical elements; *electronics* – production of liquid crystal and gas-discharge plasma display panels and other optoelectronic and display devices, including x-ray imaging; *fiber optics systems* – production of connectors and microstructure fibers; *chemistry and medicine* – production of the capillaries and micro-filters, biochips technology.

In science and technology of ionization radiation these devices are used for guiding, focusing, collimating and controlling of x-ray and neutron radiation. Grazing incidence x-ray systems based on glass mono- and poly-capillary structures are used effectively for x-ray fluorescence analysis of different materials, chemical composition, and biological structures. Shaped capillary structures with new geometries are effectively used in microdiffractometry, in micro x-ray fluorescent analysis, in x-ray photoelectron spectroscopy, in x-ray lithography, etc.

This special issue of the *Journal of X-Ray Science and Technology* is devoted to the recent achievements in the nanostructure glass technologies. It covers topics in a broad range including basic research, technology and applications of poly-capillary structures for ionizing and none-ionizing radiation guiding and focusing, diffractometry and spectroscopy. One of the priorities of the special issue is discussion of possible biomedical applications of the developed technologies.

In particular, paper written by S.O. Konorov et al. describes Raman resonances related to the stretching vibrations of water molecules inside the hollow fiber core detected in the spectrum of the four-wave mixing signal. It was proposed that phase-matched coherent anti-Stokes Raman scattering in hollow photonic-crystal fibers produced at four-wave mixing of millijoule nanosecond laser pulses guided by photonic band gaps of hollow fibers with a two-dimensionally periodic cladding may be a convenient sensing technique for condensed-phase biological species adsorbed on the inner fiber walls and trace gas detection, including exhale-gas diagnostics.

Paper by V.I. Beloglazov et al. presents studies of the spectral properties of a soft glass photonic crystal fiber designed as concentric layers of air holes of variable diameter with a central hollow core. The influence of geometry and arrangement of a fiber on its transmittance in the visible and NIR spectra was experimentally studied.

New technologies of manufacturing of polycapillary optics for x-ray engineering are discussed in another paper by V.I. Beloglazov with co-workers. It was shown that the mono- and polycapillary

0895-3996/05/$17.00

structures are produced using fiber glass technology, which consists of the repeatable pulling flown down of packages in similarity, sintering of preparations and formation form of capillary lenses. The developed policapillary structures may be used for formation of converging, diverging, and parallel beams working in a wide spectral range and allow one to realize compact x-ray analytical devices.

A. Bjeoumikhov and co-workers have suggested a real-time x-ray diffractometry based on the effectively focusing capillary lens and x-ray CCD camera without cooling.

Paper by Matti-P. Sarén and co-workers describes x-ray microdiffraction experiments on single wood cells and slices of wood. Microfibril angle distributions (MFA) in single wood cells were measured through a bordered pit using microbeam produced by capillary optics and synchrotron radiation.

A system for none-disturbing on-line control of spatial distribution of x-ray radiation is presented in the paper by V.I. Kochubey and Ju.G. Konyukhova. The system makes it possible to record images with a submicron spatial resolution and includes a lead-free glass microcapillary plate filled up by x-ray phosphor which weakly absorbs x-ray radiation.

Editors believe that in spite of a small collection of papers presented in this special issue this collection reflects the major directions of microcapillary technologies and will be useful for students and engineers involved in microcapillary optics design and applications.

Special Issue Guest-Editors

Valery V. Tuchin
Research-Educational Institute of Optics and Biophotonics at Saratov State University, Russia
E-mail: tuchin@sgu.ru

Norbert Langhoff, Institute for Scientific Instruments, GmbH, Germany
E-mail: langhoff@ifg-adlershof.de