

# **OPTICA APPLICATA**

## **INTERNATIONAL ADVISORY BOARD:**

KRZYSZTOF ABRAMSKI – physics and technology of lasers, laser metrology, optotelecommunications

OLEG V. ANGELSKY – holography, interferometry, measurements of surface roughness, fractal optics, optical vortices

SIEGFRIED BOSECK – light, electron and ultrasonic microscopy

ROMAN S. INGARDEN – diffraction theory of optical aberrations, transport of information in optical systems

EUGENIUSZ JAGOSZEWSKI – Fourier optics, holography

ROMUALD JÓZWICKI – diffraction theory of imaging, interferometry, digital holography

FRANCISZEK KACZMAREK – laser physics, nonlinear optics

HENRYK KASPRZAK – applied optics, physiological optics

BOLESŁAW KĘDZIA – physiological optics, vision process

MALGORZATA KUJAWIŃSKA – optical metrology, machine vision, opto-numerical methods and systems for multimedia and engineering

MIROSLAV MILER – wave optics, holographic methods, diffractive components, optical waveguides

JAN MISIEWICZ – optical properties of solid state, semiconductors, optoelectronics

WŁODZIMIERZ NAKWASKI – semiconductor lasers and light-emitting diodes

JAN PEŘINA – quantum, statistical and nonlinear optics

TADEUSZ STACEWICZ – laser spectroscopy and its applications

TOMASZ SZOPLIK – optical and digital image processing

TOMASZ WOLIŃSKI – fiber optic sensors and systems, optics of liquid crystals, polarization optics

JAN WÓJCIK – fabrication, measurements and applications of optical fibers

# OPTICA APPLICATA

Vol. XXXIII (2003) No. 1

PL ISSN 0078-5466

Index 367729

A joint publication of the

INSTITUTE OF PHYSICS  
WROCLAW UNIVERSITY  
OF TECHNOLOGY  
POLAND

&

SPIE/POLAND CHAPTER  
in association with  
SPIE – THE INTERNATIONAL SOCIETY  
FOR OPTICAL ENGINEERING

## Contents

**Editorial** ..... 5

### Porous glasses

JASIŃSKA B., DAWIDOWICZ A.L., GOWOREK T., WAWRYSZCZUK J., <i>Pore size determination by positron annihilation lifetime spectroscopy</i> .....	7
ANTROPOVA T.V., DROZDOVA I.A., <i>Sintering of optical porous glasses</i> .....	13
GAVRILKO T., GNATYUK I., PUCHKOVSKA G., BARAN J., MARCHEWKA M., MORAWSKA-KOWAL T., <i>Application of NIR spectroscopic method to the study of porous glasses filled with liquid crystals</i> .....	23
RYSIAKIEWICZ-PASEK E., GEVELYUK S.A., DOYCHO I.K., PROKOPOVICH L.P., SAFRONSKY E.D., <i>Effect of antibiotic insertion on photoluminescent properties of silicate porous glasses used in ophthalmologic prostheses</i> .....	33
OVECHKO V., DMYTRUK A., MYGASHKO V., <i>Physical adsorption in porous glasses</i> .....	41
EVSTRAPOV A.A., ANTROPOVA T.V., DROZDOVA I.A., YASTREBOV S.G., <i>Optical properties and structure of porous glasses</i> .....	45
DOYCHO I.K., GEVELYUK S.A., KOVALENKO M.P., PROKOPOVICH L.P., RYSIAKIEWICZ-PASEK E., <i>Small doses <math>\gamma</math>-irradiation effect on the photoluminescence properties of porous glasses</i> .....	55
REISFELD R., SARAJDAROV T., MINTI H., WODNICKA K., <i>Nanoparticles of lead sulfide in porous glasses prepared by the sol-gel method</i> .....	61
SZANIAWSKA K., MURAWSKI L., RYBICKI J., WITKOWSKA A., WALEWSKI M., <i>Gel-glass transition in silica and nitrided silica aerogels – experiment and computer modelling</i> .....	75
SODOLSKI H., GRYGIEL P., TOMASZEWICZ W., <i>Ionic transport in silica xerogels investigated by dynamic current-voltage characteristics</i> .....	83
SHAMIRYAN D., BAKLANOV M.R., YANOVITSKAYA Z.S., ZVEREV A.V., TÓKEI Z., IACOPI F., MAEX K., <i>Evaluation of thin Ta(N) film integrity deposited on porous glasses</i> .....	91

KOBEL J., PODBIELSKA H., LECHNA-MARCZYŃSKA M., ULATOWSKA-JARŻA A., <i>Mutual correlation of sol-gel optical properties and repeatability of production process examined by statistical pattern recognition methods</i> .....	97
BORSOWSKA A., SZARSKA S., JASIORSKI M., MARUSZEWSKI K., STRĘK W., <i>Optical and structural properties of sol-gel derived bioactive glasses</i> .....	107

### Special glasses

STOCH L., <i>Nanocrystalline glass-ceramics formation</i> .....	115
CHEŁSTOWSKI D., WITKOWSKA A., RYBICKI J., PADLYAK B., TRAPANANTI A., PRINCIPI E., <i>EXAFS study of glasses of the CaO–Ga<sub>2</sub>O<sub>3</sub>–GeO<sub>2</sub> system</i> .....	125
PISARSKA J., ŚLĘZOK M., ŻELECHOWER M., PISARSKI W.A., GORYCZKA T., RYBA-ROMANOWSKI W., <i>Physical properties of InF<sub>3</sub>-based glasses</i> .....	133
KUSZ B., TRZEBIATOWSKI K., GAZDA M., MURAWSKI L., <i>Structure and morphology of hydrogen reduced surface of bismuth germanate and bismuth silicate glasses</i> .....	141
NOCUŃ M., <i>Mobility of lithium ions in phosphate glass from the P<sub>2</sub>O<sub>5</sub>–Li<sub>2</sub>O–TiO<sub>2</sub>–SiO<sub>2</sub> system</i> .....	147
SIWULSKI S., NOCUŃ M., <i>Diffusion colouring of glass with silver ions</i> .....	155
ŚRODA M., STOCH L., <i>Nanocrystallization of LaF<sub>3</sub> in oxyfluoride glass</i> .....	161
STANIEWICZ-BRUDNIK B., PROCYK B., ŚRODA M., MAJEWSKA-ALBIN K., <i>Special glasses with submicrocrystalline sintered alumina admixture in cBN tools</i> .....	167
PADLYAK B.V., KUKLIŃSKI B., BUCHYNSKII P.P., <i>Optical spectroscopy of the Ho-doped glasses with 3CaO–Ga<sub>2</sub>O<sub>3</sub>–3GeO<sub>2</sub> composition</i> .....	175
NOCUŃ M., <i>Characterisation of the tin oxide conducting film obtained by ultrasonic spray pyrolysis</i> .....	183

### Optical fibres

BORECKI M., <i>Light behaviour in polymer optical fibre bend – a new analysis method</i> .....	191
NIKOLAJEW A., DOROSZ J., <i>Effect of distribution of electromagnetic field inside optical fibres on their luminous flux</i> .....	205

### Uniaxial crystals

IZDEBSKI M., KUCHARCZYK W., <i>Measurement conditions of the quadratic electrooptic coefficients along the optic axis in uniaxial crystals</i> .....	213
--	-----

## Editorial

The *6th Seminar Porous Glasses – Special Glasses PGL, 2002* was held in Szklarska Poręba, Poland on September 22–26, 2002. The Seminar was organized by the Institute of Physics, Wrocław University of Technology and Polish Ceramic Society.

The Seminar was a continuation of the series that began in Karpacz, Poland (1992) during which recent problems concerning porous glasses and special glasses were discussed. The Seminar concentrated on the technology, structure, electrical and optical properties as well as application of these materials. The papers submitted to PGL 2002 represent different sectors of the glass world: universities, research institutes; many papers were prepared jointly by research centers from different countries.

The scientific program of the Seminar included oral and poster presentations. About forty works were presented by scientists from Belgium, Russia, Israel, Ukraine and Poland.

This special issue of *Optica Applicata* contains 23 papers presented at the

### *6th Seminar Porous Glasses-Special Glasses, PGL 2002*

The papers have been grouped under the following headings: *porous glasses* and *special glasses*.

The results of investigations into the technology, structural properties and application of porous glass in optics, microelectronics and medicine are given in the first section. The glasses have been prepared from phase separated glasses and by sol-gel method.

The part concerning *porous glasses* produced from phase separated glasses included a new perspective method (annihilation lifetime spectroscopy) for investigations of pores sizes. Studies of the adsorption process and surface active centers in porous glasses before and after introducing different substances into the pores have been performed using IR spectroscopy. Several papers focused on the optical properties of porous glasses. The optical characteristics such as dispersion of refractive index and absorption coefficient have been determined for these glasses. Changes in transmission and thermal properties of porous glasses after heat treatment

have been presented. A model explaining changes of photoluminescent properties following  $\gamma$  irradiation has been developed. It has been shown that the photoluminescence method can be applied in investigation of effusion process from porous glass.

The papers presented in the second part of this section have been mainly devoted to investigations of technology and structure of porous glasses obtained by sol-gel technology. Densification process of nitrated aerogels was simulated by computer modeling using classical molecular dynamics (MD). The MD simulations have shown that densification process proceeds in the same way as observed in the experiments. Typical methods: adsorption-desorption isotherms, UV-VIS-IR spectroscopy, SEM, XRD for determining glass structure have been applied for porous glasses with PbS semiconductors nanoparticles and bioactive glass films. It has been shown that ellipsometric porosimetry can be useful in characterization of diffusion barrier integrity deposited on porous glasses which are applied in microelectronics as inter-metal dielectrics with low dielectric constant. The methods based on statistical pattern recognition have been used for the evaluation of microscopic images of so-gel matrices. For determining the sign and mobility of ions responsible for electrical conductivity inside porous xerogels the dynamic current-voltage characteristics have been applied.

The second section has been devoted to *special glasses*. The analysis of EXAFS, XDR, AFM and DCS, as well as optical absorption measurements has been proposed for investigation of the structure of germanate and  $\text{InF}_3$ -based glasses. Photoelectron spectroscopy, UV-VIS spectroscopy, XPS and SEM technique have on the contrary been applied for characterization of tin oxide thin films. Investigations of the physico-chemical and mechanical properties of boron-alumina-silicate system with addition of submicrostalline sintered alumina have also been presented. The mechanism of transformation of the structure of glass into the structure compound crystallizing in it has recently been within the focus of interest of some scientists. Diffusion coefficient and lithium mobility in lithium phosphate glass with high ionic conductivity have been defined using ac, dc and SIMS method. New information on glass colouring due to silver diffusion in glass exchange of sodium on silver ions has been obtained.

I hope that scientific sessions and informal discussions created new ideas for new projects in our special field of interest.

The Organizers thank the Polish Committee for Scientific Research (KBN) and Wrocław University of Technology for financial support.

For the Organizing Committee  
Dr. Ewa Rysiakiewicz-Pasek  
Guest Editor