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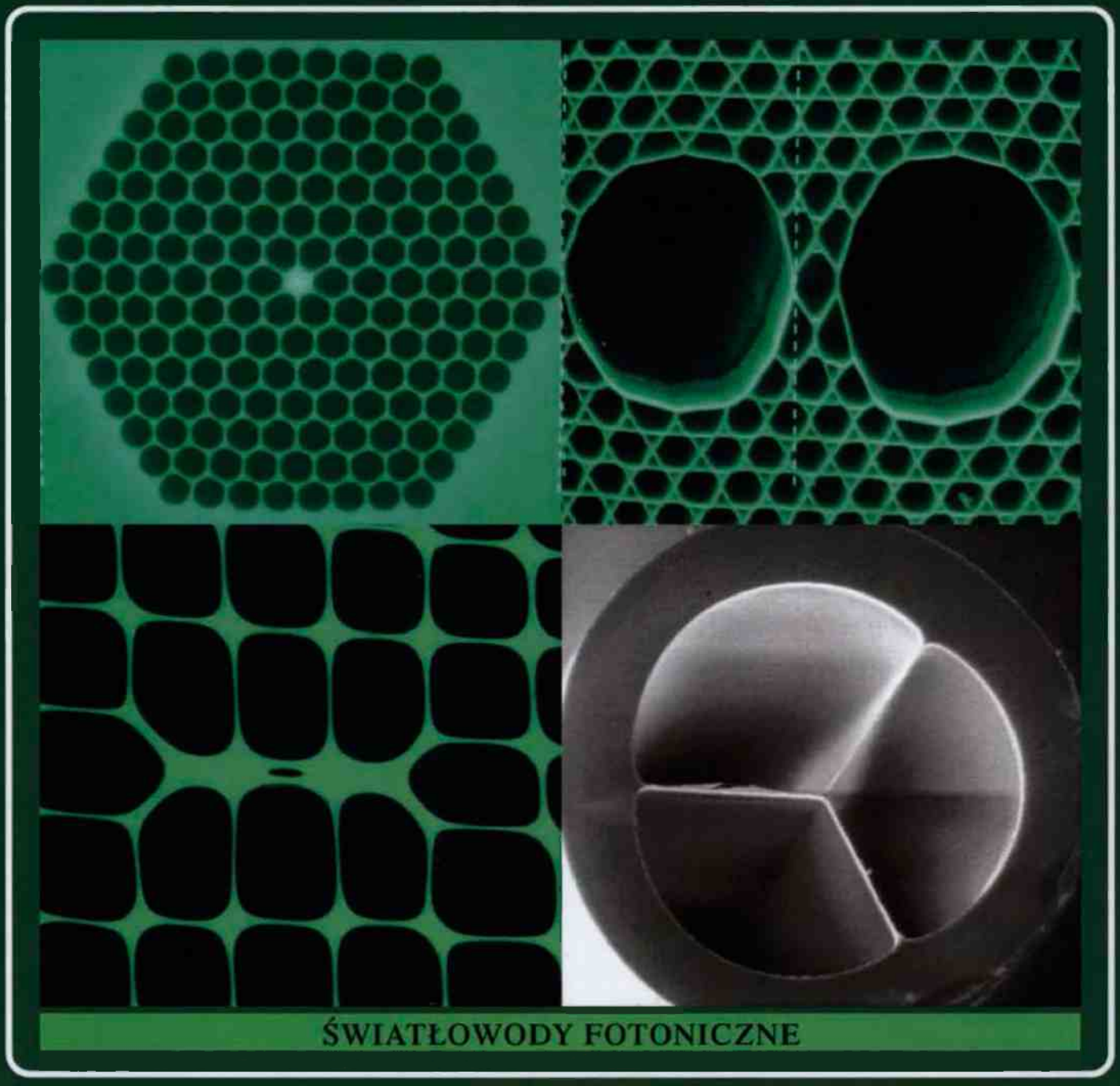
ELECTRONIC MATERIALS



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INSTITUTE OF ELECTRONIC MATERIALS TECHNOLOGY

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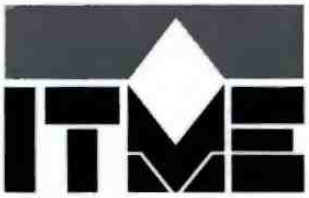

INSTYTUT TECHNOLOGII MATERIAŁÓW ELEKTRONICZNYCH
ul. Wólczyńska 133, 01-919 Warszawa

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fax: (48 22) 834 90 03
e-mail: andrzej.jelenski@itme.edu.pl

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SPIS TREŚCI

STRESZCZENIA ARTYKUŁÓW PRACOWNIKÓW ITME

Dispersion management in nonlinear photonic crystal fibres with nanostructured core

Buczyński Ryszard[1], Pysz Dariusz [1], Stępień Ryszard[1], Kasztelanic R. [2], Kujawa Irenenusz [1], Franczyk Marcin[1], Filipkowski Adam [1], Waddie A. J.[3], Taghizadeh M. R. [3]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

[2] Faculty of Physics, University of Warsaw, ul. Pasteura 7, 02-093 Warsaw

[3] Heriot-Watt University, School of Engineering and Physical Sciences, Edinburgh EH14 4AS, Scotland

Journal of the European Optical Society - Rapid Publications 6, 11038-1 - 11038-6, (2011)

The subwavelength structure of the core of a photonic crystal fibre can modify its dispersion characteristic and significantly shift the zero dispersion wavelength. The dispersion properties of photonic crystal fibres with core structures made of a 2D lattice of subwavelength air holes and various glass inclusions are studied. We show that a modification of the core structure can give flat dispersion over a range of over 300 nm and can shift the zero dispersion wavelength over 700 nm while the core diameter and photonic cladding remain unchanged. The developed photonic crystal fibre with nanorod core has successfully demonstrated supercontinuum generation in NIR.

Supercontinuum generation on photonic crystal fibers with nanoporous core made of soft glass

Buczyński Ryszard[1,2,3], Pysz Dariusz [2], Stępień Ryszard[2], Waddie A.J.[3], Kujawa Ireneusz[2], Kasztelanic R.[1], Franczyk Marcin[2], Taghizadeh M.R.

[1] Faculty of Physics, University of Warsaw, ul. Pasteura 7, 02-093 Warsaw

[2] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

[3] Heriot-Watt University, School of Engineering and Physical Sciences, Edinburgh EH14 4AS, Scotland

Laser Physics Letters, 8, 6, (2011), 443 - 448

In this paper we report on the fabrication of a photonic crystal fiber with nanoporous core made of in house synthesized silicate glass. The fiber uses three rings of holes around a core with a diameter of 4,7 μm. It effectively guides two modes with broadband flat normal dispersion and zero dispersion wavelengths at 1.0 and 1.6 μm, We have demonstrated supercontinuum generation in the range 600-940 nm with a spectra flatness variation below 8 dB when a fiber sample 23 cm long is pumped with 60 fs pulses with a central wavelength of 806 nm and pulse energy of 2.4 nJ.

High-resolution photoinduced transient spectroscopy of defect centres in semi-insulating GaP

Kamiński Paweł, Kozłowski Roman, Strzelecka Stanisława, Hruban Andrzej, Jurkiewicz-Wegner Elżbieta, Piersa Mirosław

Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

Physica Status Solidi C, 8, 4, (2011), 1361 - 1365

High-resolution photoinduced transient spectroscopy (HRPITS) has been applied to study electronic properties of point defects in semi-insulating (SI) GaP obtained by high temperature annealing under phosphorus (P) vapour pressure. The parameters of defect centres are extracted from the photocurrent relaxation waveforms, recorded in a wide temperature range of 30–600 K, by means of a two-dimensional spectral analysis based both on the correlation procedure and inverse Laplace transform algorithm. The defect structure of GaP wafers whose SI properties resulted from the annealing under the P vapour pressures of ~ 0.05 MPa and ~ 0.2 MPa is compared.

Effect of solubility YAG:Nd nanocrystals in glass matrix

Szysiak Agnieszka [1], Ryszard Stępień[1], Ryba-Roma-

nowski W.[2], Solarz P.[2], Mirkowska Monika[1], Lipińska Ludwika[1], Pajączkowska Anna[1]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

[2] Institute of Low Temperature and Structure Research, Polish Ac. Sc., P.O. Box 1410, 50-950 Wroclaw

Materials Research Bulletin, 46, (2011), 1566-1570

The nanocomposites of $Y_3Al_5O_{12}:Nd^{3+}$ (YAG:Nd) incorporated in borate glass were obtained. The single phase of YAG:Nd nanocrystals were obtained by sol–gel method. The borate glass was melted first and ground up then mixed with the nanocrystals. The samples were formed into pellets under pressure and were annealed in temperatures from the range 550–800°C. The X-ray diffraction patterns show that together with increasing the temperature the contribution of $Y_3Al_5O_{12}$ phase decreases and the new $YBa_3B_9O_{19}$ phase is observed. The luminescence measurements indicates that the band structures and distribution of band intensities of glass-YAG:Nd nanocrystal composites depends crucially on annealing temperature.

Solubility of YAG:Nd in borate glass–luminescence and Raman investigation

Ryba-Romanowski W.[1], Solarz P.[1], Kasprowicz D.[2], Runka T.[2], Szysiak Agnieszka[3], Stępień Ryszard[3]

[1] Institute of Low Temperature and Structure Research, Polish Academy of Sciences, ul. Okólna 2, 50-422 Wrocław

[2] Faculty of Technical Physics, Poznań University of Technology, ul. Nieszawska 13 A, 60-965 Poznań

[3] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

Journal of Alloys and Compounds, 509, (2011), 6280-6284

YAG:Nd powders obtained by grinding a single crystal and synthesized by modified sol–gel and combustion methods were embedded at the stage of melting in a multicomponent borate glass to obtain luminescent glass–ceramic systems. Room temperature optical absorption spectra, luminescence spectra at room temperature and at 10 K and micro-Raman spectra were recorded to determine the location of Nd^{3+} ions in composite materials. It has been concluded that their luminescence characteristics depend critically on the preparation method hence the morphology of precursor crystalline YAG:Nd powders as a consequence of dissimilar solubility of crystallites in a host glass.

Concept of epitaxial silicon structures for edge illuminated solar cells

Jerzy Sarnecki[1], Grzegorz Gawlik[1], Marian Teodorczyk[1], O. Jeremiasz[2], Roman Kozłowski[1], Dariusz Lipiński[1], Krzysztof Krzyżak[1], Andrzej Brzozowski[1]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01–919 Warsaw

[2] ABRAXAS, ul. Piaskowa 27, 44–300 Wodzisław Śląski

Opto-Electronics Review 19(4),486-490, (2011)

A new concept of edge illuminated solar cells (EISC) based on silicon epitaxial technique has been proposed. In this kind of photovoltaic (PV) devices, sun–light illuminates directly a p–n junction through the edge of the structure which is perpendicular to junction surface. The main motivation of the presented work is preparation of a working model of an edge–illuminated silicon epitaxial solar cell sufficient to cooperation with a luminescent solar concentrator (LSC) consisted of a polymer foil doped with a luminescent material. The technological processes affecting the cell I–V characteristic and PV parameters are considered.

Growth of a plate-shaped $SrTiO_3TiO_2$ eutectic

Krzysztof Bieńkowski[1,2], Sebastian Turczyński[1], Ryszard Diduszko[1], Marcin Gajc[1], Ewa Górecka[1], Dorota A. Pawlak[1]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

[2] Chemistry Department, University of Warsaw, ul. Pasteura 1, 02-093 Warsaw

Crystal Growth and Design

Eutectic materials have potential as photoactive materials, due to their multiphase character (various available photoactive component phases and multiple band gap energies) and high crystallinity. However, larger material samples are needed to demonstrate it. In order to overcome this limitation, the growth of a plate-shaped $SrTiO_3TiO_2$ eutectic, generated using the micropulling-down method, has been studied. Growth has been performed with different seeds and different pulling rates, which yielded 2 x 10 x 40 mm^3 samples. Both phases in the eutectic present distinct crystallographic orientations. During the well-controlled growth process, column-like growth of the TiO_2 phase is clearly observed on the side surface of the as-grown eutectic. In uncontrolled processes, growth of inverted $SrTiO_3$ pyramids on the side surface was observed. The size of the obtained eutectic samples is sufficient for laboratory scale photoelectrochemical measurements. The growth of the plate-shaped eutectic is presented and discussed in terms of eutectic structure. Due to its eutectic nature, this new material may show improved photoelectrochemical behavior in comparison to its component phases.

Properties of SAW synchronous two-port resonators on $GdCa_4O(BO_3)_3$ crystal

Waldemar Soluch, Life Senior Member, IEEE

Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01–919 Warsaw

IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, 58, 2 485-488, (2011)

Surface acoustic wave (SAW) synchronous two-port resonators were fabricated and measured on several orientations of the $GdCa_4O(BO_3)_3$ crystal. Resonance frequencies, insertion losses, and unloaded quality factors of the resonators, measured at room temperature, were in the ranges of about 432.3 to 437.5 MHz, 3.8 to 6.3 dB, and 6500 to 7500, respectively. The properties of this crystal, such as its lack of a phase transition up to its melting temperature of about 1500°C, a SAW temperature coefficient of frequency of about −80 ppm/°C, and good parameters of the resonators make the crystal attractive for high-temperature sensor applications.

The use of analytical methods in evaluation of coptic wall paintings conservation - A case study

M. Ali[1], S. Abd El Aal[2], G. Mahgoub[2], A. Sihame[3], Andrzej Turos[4 5], A. Kormand[4], A. Stonert[5]

[1] Faculty of Archaeology, Conservation Deptartment, Cairo University, Egypt

[2] Faculty of Archaeology, Conservation Department, Fayoum University, Egypt

[3] National Research Center, Dokki, Cairo, Egypt

[4] Soltan Institute of Nuclear Studies, 05-400 Otwock/Swierk,

[5] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

Acta Physica Polonica A, 120, 1, 171-175, (2011)

Egypt has a lot of ancient monasteries and churches, which were decorated with different kinds of wall paintings. Structure of these wall paintings consists of support, plaster and painting layers. Paintings deterioration is primarily due to physicochemical, natural and human factors. The most detrimental factors are bat patches, old varnish and organic waste of birds. All these lead to the gradual disappearance of paintings. Modern technology of conservation is focused on application of new materials for cleaning of wall paintings. Here we report on the use of enzymes, for cleaning surface of coptic wall paintings. Analytical techniques such as particle induced X-ray emission, Fourier transform infrared and optical microscopy were used to evaluate the enzymatic cleaning processes of coptic wall paintings and to identify the chemical composition of red, yellow and white pigments. Particle induced X-ray emission results indicated that there is no change in the chemical composition of the materials and pigments due to enzymatic cleaning. Fourier transform infrared and optical microscopy results confirmed the stability of organic medium before and after treatment of different kind of patches.

Assessment of gadolinium calcium oxoborate (GdCOB) for laser applications

Bajor Andrzej L.[1], Kisielewski Jarosław[1], Kłos Andrzej[1], Kopczyński K.[2], Łukasiewicz Tadeusz[1], Mierczyk J.[2], Młyńczak J.[2]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01–919 Warsaw

[2] Institute of Optoelectronics, Military University of Technology, ul. Kaliskiego 2, 00–908 Warsaw

Opto-Electronics Review, 19, 4, 439-448, (2011)

Increasing demand for growing high quality laser crystals puts a question about their most important parameters that one should concentrate on to get a desired product which will exhibit best properties in practical use. And by no means, this is a simple question. Apart of the usual lasing properties associated with a special dopant in the host material itself, one needs to consider another two lasing phenomena, namely second (SHG) and higher harmonic generation, and self–frequency doubling (SFD). Not necessarily all of these three can meet altogether in the same host material to yield in its best appearance in every case. We have made a review of basic properties of gadolinium oxoborate $GdCa_4O(BO_3)_3$ (GdCOB) crystal and came to the conclusion that, currently, as a host material this is probably the best in all of its lasing applications. Although GdCOB has low thermal conductivity, which requires a suitable cooling, on the other hand it has got small thermo–optic coefficients which govern good operation in SHG and SFD experiments.

Two inch dia. Nd–doped crystals were grown by the Czochralski technique. Since a large discrepancy in the literature exists on exact values of nonlinear coefficients, one is never sure about this whether theoretically predicted phase–matching angles (PMA) are those that are really optimal. Besides, none has yet measured the values of nonlinear coefficients as a function of doping concentration. Therefore we have not decided to cut numerous differently oriented samples for generation of different wavelengths in SHG and SFD, but rather tried to generate different wavelengths from the same samples. We have also not paid special attention to get highest possible conversion efficiencies. However, we have con-

centrated our attention on potential use of the core region in laser technique. Unlike in YAG crystals, when the core is by all means a parasitic structure, we discovered that the core region in GdCOB, that majority of investigators are even not aware of its presence in the crystal, can be also useful in laser technique. According to our best knowledge, a SHG of red light in this work is the second reported case in the world−wide literature.

Growth of GaN epilayers on c-, m-, a-, and (20.1)-plane GaN bulk substrates obtained by ammonothermal method

Rudziński Mariusz[1], Kudrawiec R.[2], Janicki L.[2], Serafinczuk J.[3], Kucharski R.[4], Zając M.[4], Misiewicz J., Doradziński R.[4], Dwiliński R.[4], Strupiński Wlodzimierz[1]

[1] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01-919 Warsaw

[2] Institute of Physics, Wroclaw University of Technology, ul. Wybrzeże Wyspiańskiego 27, 50-370Wroclaw

[3] Faculty of Microsystem Electronics and Photonics, Wroclaw University of Technology, ul. Janiszewskiego 11/17, 50-372 Wrocław

[4] AMMONO sp. z o.o. ul. Czerwonego Krzyża 2/31, 00-377 Warsaw

Journal of Crystal Growth, 328, 5-12, (2011)

GaN epilayers were grown by metalorganic chemical vapor deposition (MOCVD) on c-, m-, a-, and (20.1)-plane GaN substrates obtained by the ammonothermal method. The influence of (i) the surface preparation of substrates, (ii) MOCVD growth parameters, and (iii) the crystallographic orientation of substrates on the structural and optical properties of GaN epilayers was investigated and carefully analyzed. It was observed that the polishing of substrates and their misorientation have strong impact on the quality of GaN epilayers grown on these substrates. The MOCVD growth process was optimized for epilayers grown on m-plane GaN substrates. The best structural and optical properties were achieved for epilayers deposited at 1075°C and the total reactor pressure of 50 mbar. These conditions were applied to grow GaN epilayers on substrates with other (c-, a-, and (20.1)-plane) crystallographic orientations in the same MOCVD process. Particularly good optical properties were obtained for GaN epilayers deposited on polar and non- polar (*m*- and α-plane) substrates,where as slightly worse optical properties were observed for epilayers deposited on the semi-polar substrate. It therefore means that MOCVD growth conditions optimized for a given crystallographic direction (*m*-plane direction in this case) work rather well also for other crystallographic directions.

Investigations on printed elastic resistors containing carbon nanotubes

Sloma Marcin[1], Jakubowska Malgorzata [1,2], Kolek .[3], Mleczko K.[3], Ptak P.[3], Stadler A. W.[3], Zawiślak B.[3], Młożniak Anna[2]

[1] Institute of Metrology and Biomedical Engineering, Faculty of Mechatronics, Warsaw University of Technology, ul. Św. A. Boboli 8, 02-525 Warsaw

[2] Institute of Electronic Materials Technology, ul. Wólczyńska 133, 01−919 Warsaw

[3] Department of Electronics Fundamentals, Faculty of Electrical and Computer Engineering, Rzeszów University of Electrical and Computer Engineering, Rzeszów University of Technology, ul. W. Pola 2, 35-959 Rzeszów

Journal of Materials Science: Mater Electron 22, (2011) 1321-1329

This paper presents the results of authors investigations on elaboration of a new thick film composition filled with carbon nanotubes (CNTs). The polymer composition consists of polymer vehicle, which is the solution of organic resin in certain combination of solvents, and functional phase—carbon nanotubes well dispersed in the vehicle. The pastes were applied with screen-printing on several substrates and temperature cured. The properties of obtained layers were characterized. Series of samples were prepared with different amount of CNTs to evaluate electrical properties. Changes in resistance were investigated during periodic mechanical and temperature stresses, realized through cyclical bending and rapid temperature change. Tensometric effect was also investigated. Investigations have proved that polymer composites based on carbon nanotubes exhibit high resilience to stress factors.

Resistance change in function of temperature was also investigated to evaluate temperature coefficient of resistance (TCR). All this aspects are important for elastic resistors fabrication in printed electronics microcircuits. Resistance and noise measurements in cryostats have also been involved. 1/f type noise has been observed. Noise intensity, calculated in decade frequency bands, rises significantly with increasing temperature. Activation energies of thermally activated noise sources (TANS) have been revealed using low-frequency noise spectroscopy. Relatively large value of negative TCR has been obtained from resistance versus temperature curve. Calculated dimensionless sensitivity is similar to that observed in cryogenic temperature sensors. However, bulk noise intensity of resistive layer is larger than obtained for lead containing RuO_2 based resistive layers.

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INSTYTUT TECHNOLOGII
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Instytut prowadzi również badania i wykonuje usługi w zakresie:

- **innych technologii HI-TECH**: fotolitografia, elektronolitografia, osadzanie cienkich warstw, trawienie, obróbka termiczno;
- **charakteryzacji materiałów:** spektrometria mas i Mössbauera, elektronowy rezonans paramagnetyczny (EPR), rozpraszanie wsteczne Rutheforda (RBS), absorpcja atomowa, wysokorozdzielcza dyfrakcja rentgenowska, spektroskopia optyczna i w podczerwieni (FTIR), pomiary widm promieniowania, fotoluminescencja, mikroskopia optyczna i skaningowa mikroskopia elektronowa i sił atomowych (AFM); spektroskopia głębokich poziomów: pojemnościowa (DLTS) i fotoprądowa (PITS), pomiary impedancyjne i szumów, temperaturowa analiza fazowa, pomiary dyfuzyjności ciepła.