EAgLE

European Action towards Leading Centre for Innovative Materials

FP7-REGPOT-2012-2013

EAgLE
European Action towards Leading Centre for Innovative Materials

Research and nanotechnology in the Institute of Physics PAS

IF PAN

EAgLE

On October 17, 2013 the Institute of Physics of the Polish Academy of Sciences celebrated of the 60th anniversary of its foundation

President's Minister Henryk Wujec

The celebration was organized under honorary patronage
of the President of the Republic of Poland
Bronisław Komorowski

Structure of IF PAN

INSTITUTE OF PHYSICS PAS in WARSAW
Director: Professor Leszek Sirko
Chairman of the Research Council: Professor Jacek Kossut

SCIENTIFIC DIVISION (ON-1)
PHYSICS OF SEMICONDUCTORS
Professor Tomasz Story

SCIENTIFIC LABORATORY (SL-1)
X-RAY AND ELECTRON MICROSCOPY RESEARCH
Professor Krystyna Jabłońska

SCIENTIFIC DIVISION (ON-2)
RADIATION PHYSICS AND SPECTROSCOPY
Professor Bolesław Kozankiewicz

SCIENTIFIC LABORATORY (SL-2)
CRYOGENIC AND SPINTRONIC RESEARCH
Professor Tomasz Dietl

SCIENTIFIC DIVISION (ON-3)
PHYSICS OF MAGNETISM
Professor Andrzej Wiśniewski

SCIENTIFIC LABORATORY (SL-3)
GROWTH AND PHYSICS OF LOW DIMENSIONAL CRYSTALS
Professor Jacek Kossut

SCIENTIFIC DIVISION (ON-4)
PHYSICS AND TECHNOLOGY OF WIDE-BAND-GAP SEMICONDUCTOR NANOSTRUCTURS
Professor Andrzej Suchocki

SCIENTIFIC LABORATORY (SL-4)
LABORATORY OF BIOLOGICAL PHYSICS
Professor Marek Cieplak

Employment in 2014

Number of employees of IP PAS (31.12. 2014):

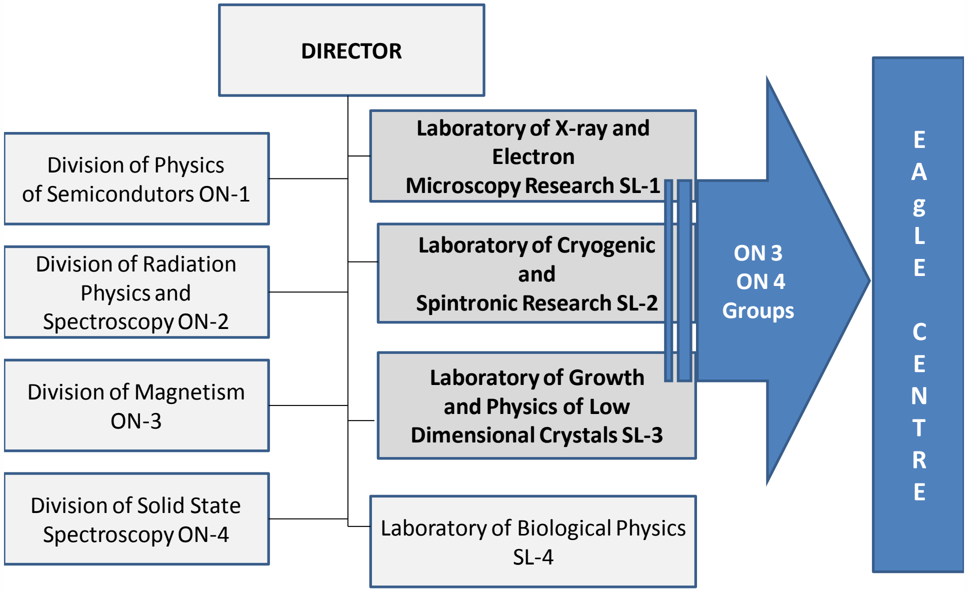
Number of employees: **385**

- Professors: **46**
- Associate Professors: ***26***
-***Assistant Professors:*** ***71***
-***Visiting Professors:*** ***1***

Number of Ph.D. students in the International Post-Graduate Studies of the Polish Academy of Sciences: 68

The EAgLE staff

The EAgLE staff includes **94 members with 11 Professors, 13 Associate Professors and 37 PhD holders** selected from research groups located in 3 Laboratories and 2 Divisions within the organisational scheme of IF PAN.



Objectives of the EAgLE Project

The EAgLE Project is implemented by pursuing five objectives which are in line with the requirements of the RegPot-2012-2013 -1 call:

Objective 1
Enhancement of human capacity through twinning activities with leading European research centres, also in the emerging now R&D areas, the recruitment of experienced researchers, organization of and participation in workshops, and topical conferences.

Objective 2
Enhancement of technical capacity via the purchasing of new equipment and upgrading the existing facilities in the EAgLE laboratories, by exploiting the capabilities of European large facilities, and by developing appropriate theoretical and computational tools.

Objectives of the EAgLE Project, cnt.

Objective 3
Fostering of the innovation and promoting cooperation with industry by identifying the market needs, evoking entrepreneur spirit, and developing IPR strategy within the IF PAN as well as by adapting laboratories, characterization protocols, and computational methods in order to deliver world-top expertise for industrial users.

Objective 4
Better integration in ERA by twinning activities with leading European research centres, organisation of focussed events, participation in international and European events, particularly foreseeing pan-European needs and project calls.

Objective 5
Increasing the visibility of the EAgLE capabilities and accomplishments through dissemination and promotion activities among following stakeholders: industry, academia, regional and national authorities as well as public at large.

Budget and resources of the project

	Direct costs (Personnel; Other direct)	Subcontracting	Indirect costs 7% (reimbursed by EC)	Requestes EU contribution	Total Indirect costs	Total costs
WP 1	205 850,00 €	12 870,00 €	14 409,50 €	233 129,50 €	41 170,00 €	259 890,00 €
WP 2	929 800,00 €	0,00 €	65 086,00 €	994 886,00 €	185 960,00 €	1 115 760,00 €
WP 3	1 091 400,00 €	17 208,00 €	76 398,00 €	1 185 006,00 €	218 280,00 €	1 326 888,00 €
WP 4	1 380 000,00 €	99 000,00 €	96 600,00 €	1 575 600,00 €	276 000,00 €	1 755 000,00 €
WP 5	472 640,00 €	17 488,00 €	33 084,80 €	523 212,80 €	94 528,00 €	584 656,00 €
WP 6	260 550,00 €	70 257,00 €	18 238,50 €	349 045,50 €	52 110,00 €	382 917,00 €
WP 7	84 150,00 €	3 000,00 €	5 890,50 €	93 040,50 €	16 830,00 €	103 980,00 €
Total:	**4 424 390,00 €**	**219 823,00 €**	**309 707,30 €**	**4 953 920,30 €**	**884 878,00 €**	**5 529 091,00 €**

Scientific activity in 2014

Published papers: 811, including:

- Papers published in journals with “Impact Factors” > 0: 264

- Papers published in other journals: 52

- Monographs: 4

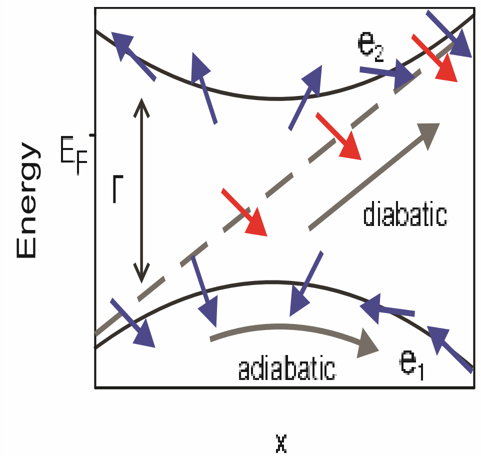
- Conference papers: 491

20 JULY 2012 VOL 337 SCIENCE www.sciencemag.org

Spin-Transistor Action via Tunable Landau-Zener Transitions

C. Betthausen,[1] T. Dollinger,[2] H. Saarikoski,[2] V. Kolkovsky,[3] G. Karczewski,[3]
T. Wojtowicz,[3] K. Richter,[2] D. Weiss[1]*

Spin-transistor designs relying on spin-orbit interaction suffer from low signal levels resulting from low spin-injection efficiency and fast spin decay. Here, we present an alternative approach in which spin information is protected by propagating this information adiabatically. We demonstrate the validity of our approach in a cadmium manganese telluride diluted magnetic semiconductor quantum well structure in which efficient spin transport is observed over device distances of 50 micrometers. The device is turned "off" by introducing diabatic Landau-Zener transitions that lead to a backscattering of spins, which are controlled by a combination of a helical and a homogeneous magnetic field. In contrast to other spin-transistor designs, we find that our concept is tolerant against disorder.

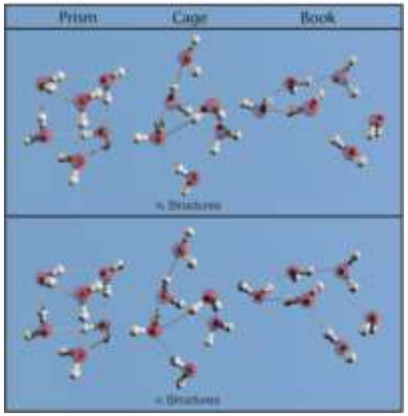


www. sciencemag.org SCIENCE VOL 336 18 MAY 2012

Structures of Cage, Prism, and Book Isomers of Water Hexamer from Broadband Rotational Spectroscopy

Cristóbal Pérez,[1] Matt T. Muckle,[1] Daniel P. Zaleski,[1] Nathan A. Seifert,[1] Berhane Temelso,[2]
George C. Shields,[2]* Zbigniew Kisiel,[3]* Brooks H. Pate[1]*

Theory predicts the water hexamer to be the smallest water cluster with a three-dimensional hydrogen-bonding network as its minimum energy structure. There are several possible low-energy isomers, and calculations with different methods and basis sets assign them different relative stabilities. Previous experimental work has provided evidence for the cage, book, and cyclic isomers, but no experiment has identified multiple coexisting structures. Here, we report that broadband rotational spectroscopy in a pulsed supersonic expansion unambiguously identifies all three isomers; we determined their oxygen framework structures by means of oxygen-18–substituted water ($H_2^{18}O$). Relative isomer populations at different expansion conditions establish that the cage isomer is the minimum energy structure. Rotational spectra consistent with predicted heptamer and nonamer structures have also been identified.



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Oleh Hul, Michał Ławniczak, Szymon Bauch, Adam Sawicki, Marek Kuś, and Leszek Sirko,
Are scattering properties of graphs uniquely connected to their shapes?
Phys. Rev. Lett. 109, 040402 (2012) .

PRL 109, 208101 (2012) PHYSICAL REVIEW LETTERS week ending 16 NOVEMBER 2012

Cystine Plug and Other Novel Mechanisms of Large Mechanical Stability in Dimeric Proteins

Mateusz Sikora and Marek Cieplak*
Institute of Physics, Polish Academy of Sciences, Al. Lotników 32/46, 02-668 Warsaw, Poland
(Received 3 April 2012; published 13 November 2012)

We identify three dimeric proteins whose mechanostability is anisotropic and should exceed 1 nN along

nature materials LETTERS
PUBLISHED ONLINE: 30 SEPTEMBER 2012

Topological crystalline insulator states in $Pb_{1-x}Sn_xSe$

P. Dziawa[1], B. J. Kowalski[1], K. Dybko[1], R. Buczko[1], A. Szczerbakow[1], M. Szot[1], E. Łusakowska[1], T. Balasubramanian[2], B. M. Wojek[3], M. H. Berntsen[3], O. Tjernberg[3]* and T. Story[1]*


nature photonics

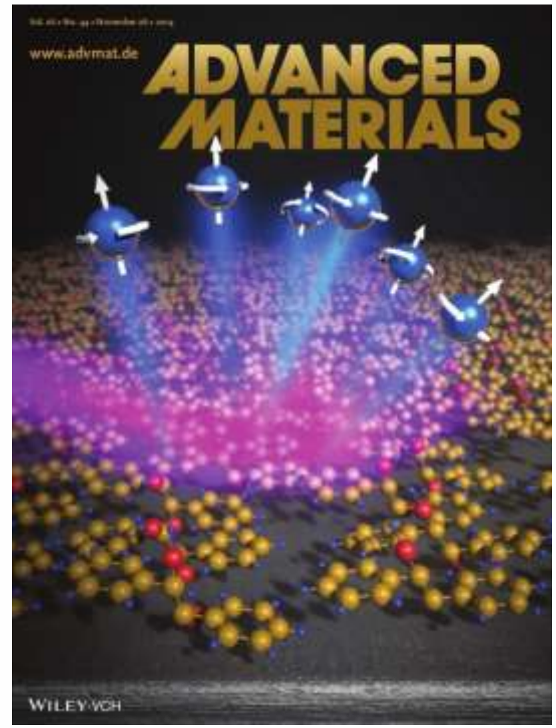
ARTICLES

Access to long-term optical memories using photon echoes retrieved from semiconductor spins

L. Langer, S. V. Poltavtsev, I. A. Yugova, M. Salewski, D. R. Yakovlev, G. Karczewski, T. Wojtowicz, I. A. Akimov* and M. Bayer

Physics Faculty, TU Dortmund University, Germany

Miguel Niño, Iwona Kowalik, Francisco Luque, Dimitri Arvanitis, Rodolfo Miranda and Juan de Miguel, *Enantiospecific Spin Polarization of Electrons Photoemitted Through Layers of Homochiral Organic Molecules*, Advanced Materials 26, 7474 (2014).



Division of Molecular and Condensed Matter Physics, Uppsala University, Sweden

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Research projects in 2014

All together:	**140**
- Statute projects:	**24**
- Individual grants from the Ministry of Science and Higher Education:	**76**
- Projects from the Programme Innovative Economy (POIG):	**6**
- Foundation for Polish Science:	**5**
- Supplementary grants from MSHE:	**4**
- International research projects:	**4**
- Other projects:	**18**

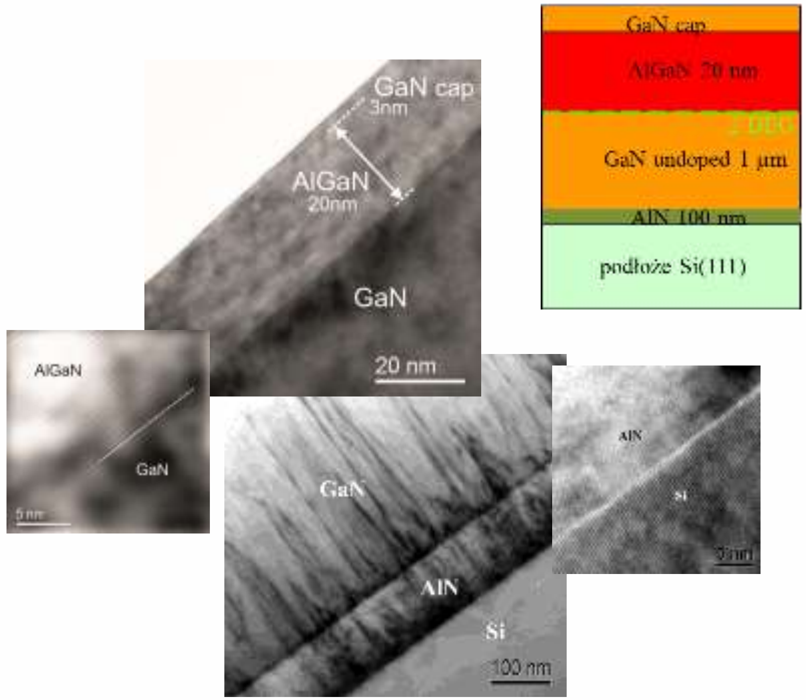
International collaboration in 2013 – 2014
(WP2,WP6)

	2013		2014	
	all	EAgLE	all	EAgLE
Scientific visits to IF PAN	81	29	146	94
Visits to other Institutions	348	14	448	69

Fabrication of new materials

Double reactor MBE machine for the growth of ZnO and GaN heterostructures

HEMT AlGaN/GaN structures for application in microelectronics and biological sensors



Grown in the group of Prof. Z. Żytkiewicz

Atomic Layer Deposition reactors

Coating specifications:

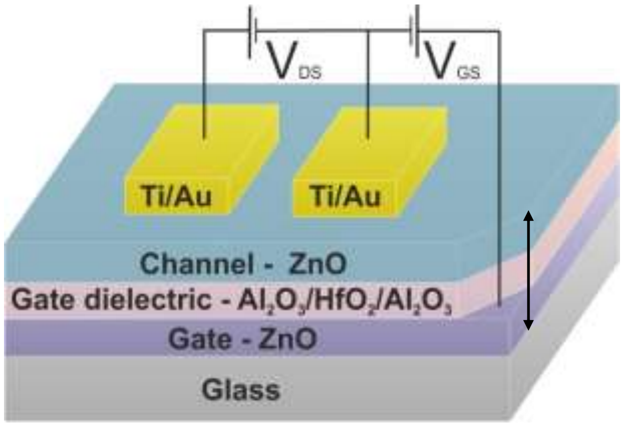
- max. substrate size: **ø 10 cm**
- max. substrate height: **0.6 cm → *6 cm***
- growth speed: **~0.01 nm/s**

Coating specifications:

- max. substrate size: **ø 20 cm**
- max. substrate height: **0.3 cm**
- growth speed: **0.04-0.08 nm/s**

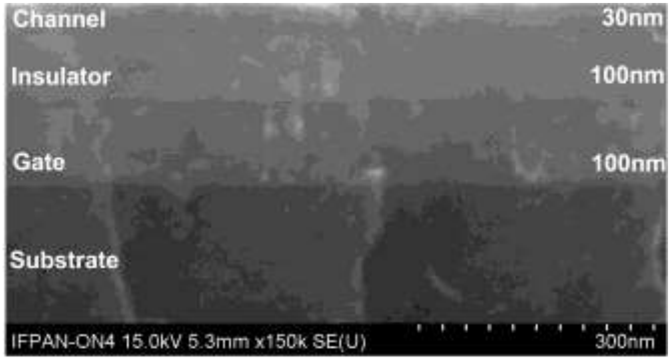
Thin Film structures grown by ALD

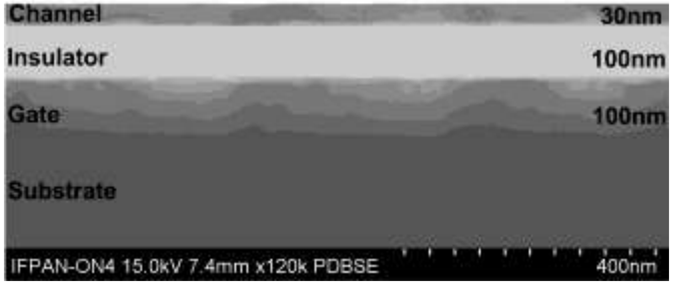
Thin Film Transistor deposited on trasparent substrate



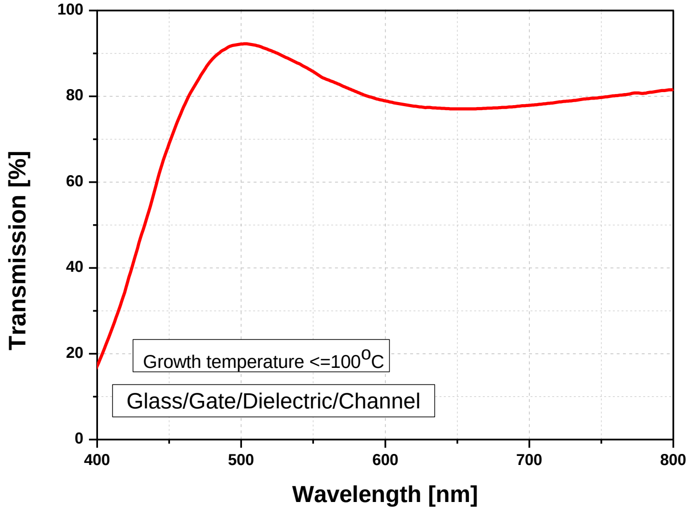
Atomic Layer Deposition

Growth temperature: **≤ 100°C**





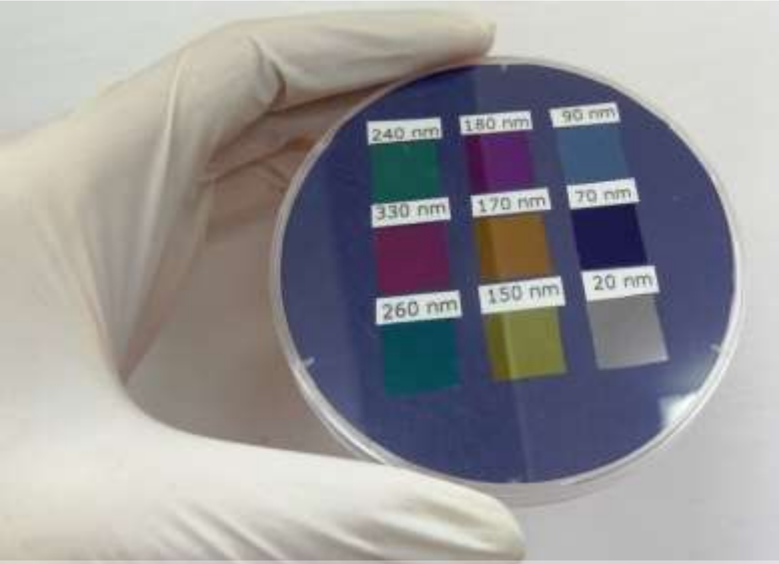
Cross-section SEM image of ZnO-TFT with high-k gate dielectric



Optical transmission spectra

Transmission average: ~85%

Properties of oxide layers grown by ALD

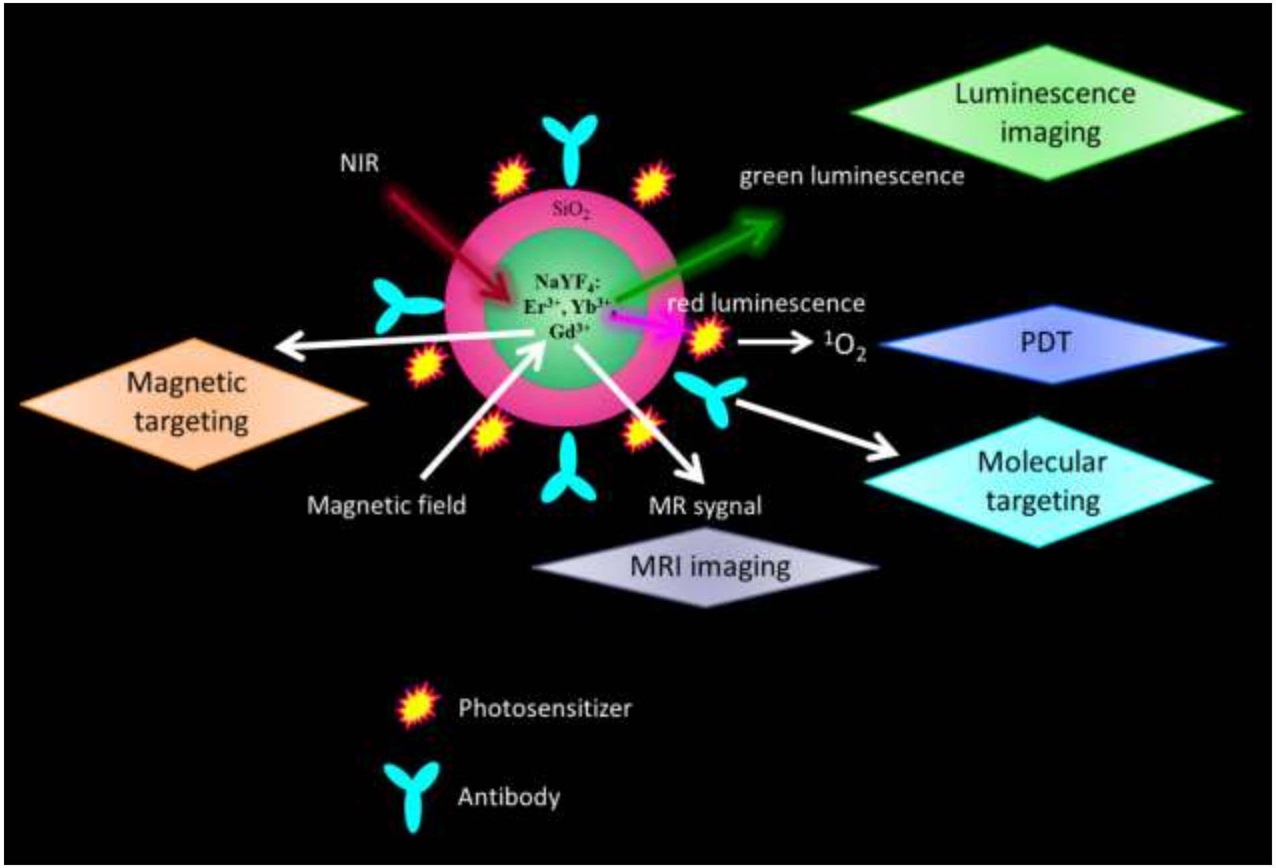


Oxide films with different thickness on Si

Properties of our oxide thin films:

- Uniformity of coatings
- Color (aesthetic properties)
- Antibacterial properties
- Average transmission in visible spectra:> 80%
- Hydrophobic properties
- Protective coatings (external factors, corrosion, oxidation)

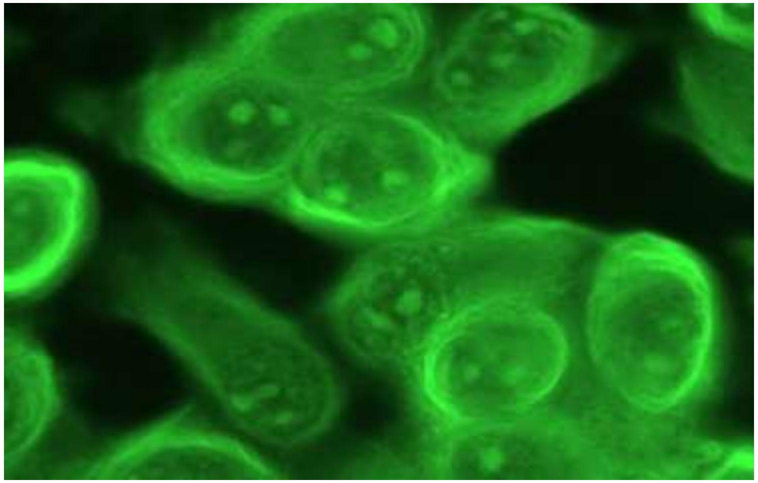
Multifuctional upconverting nanoparticles



Upconverting nanoparticles synthesised in the group of prof. Danek Elbaum

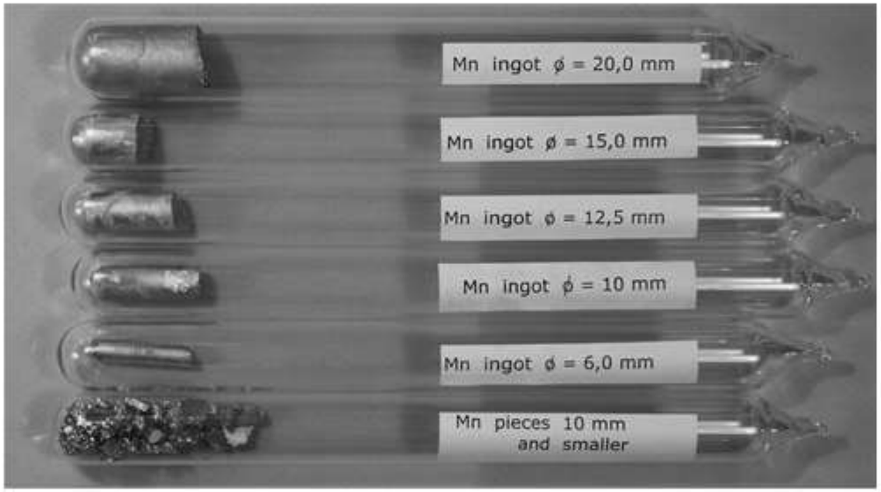
Core-shell ZnO/MgO quantum dots

synthesis by sol-gel method



HeLa Cells labelled with ZnO/MgO quantum dots (biosensors)
Fluorescence Microscopy: Ext- 340 nm, Em-540 nm.

PURE MATERIALS FOR MBE AND OTHER SEMICONDUCTOR TECHNOLOGIES



ULTRAPURE MANGANESE $_{25}Mn^{54.936}$ (m5N8; t5N7)*

FOR MBE AND OTHER SEMICONDUCTOR TECHNOLOGIES

NEW METHOD OF PURIFICATION** - particularly effective for removal of oxygen, carbon and sulfur contaminants

RESULTS OF ANALYSES by the atomic absorption spectroscopy and the spark source mass spectrometry (in ppm):

Li < 0.05	Na < 0.03	P < 0.1	Ca < 0.08	Cu < 0.2
B < 0.01	Mg < 0.06	S < 0.07	Cr < 0.08	Zn < 0.2
C < 0.1	Al ≈ 0.5	Cl < 0.1	Fe < 0.5	
F < 0.1	Si ≈ 0.8	K < 0.08	Ni < 0.1	

Available Products:

- **Pieces** 10 mm and smaller (see photograph)
- **Ingots** Φ = 6, Φ = 10, Φ = 12.5, Φ = 15, Φ = 17 and Φ = 20 mm and 20÷30 ± 3 mm length (see photograph)

Note: density of Mn is ≈ 7.4 g/cm^3

ALL PRODUCTS are vacuum packed in glass ampoules to prevent oxidation

DELIVERY TIME for all products: 2-3 weeks. Note: a number of pieces (≈ 50÷100g) are always in store, ready to dispatch immediately.

CONTACT: **Prof. Andrzej MYCIELSKI**
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Polish Academy of Sciences
Al.Lotników 32/46, 02-668 Warsaw, POLAND
Fax: (+48 22) 843 09 26; Tel. (+48 22) 843 56 26
e-mail: mycie@ifpan.edu.pl
http://www.ifpan.edu.pl/ultrapure/

* The prefix "m" indicates purity with respect to the metallic content only; the prefix "t" indicates purity with respect to all contaminants. "N" signifies a number of "9's"

** The author (A.M.) was nominated in 2000 to the Economic Prize of the President of the Republic of Poland.

The construction of the technological equipment for the purification processes has been financed in part by the Foundation For Polish Science.

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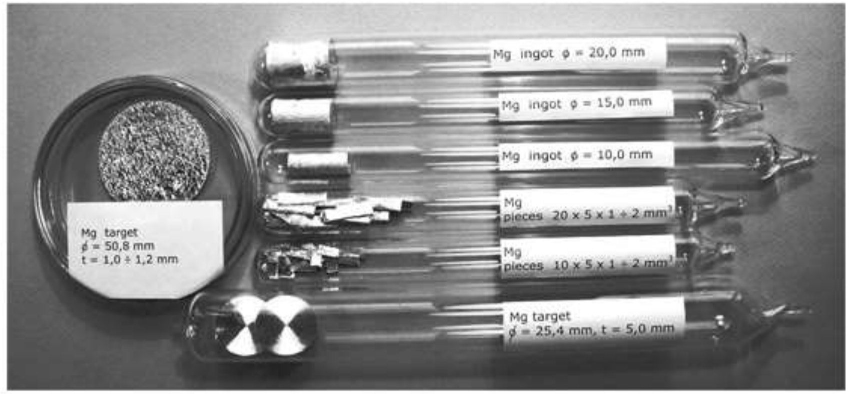

ULTRAPURE MAGNESIUM $_{12}Mg^{24.312}$ (m6N; t5N8)*

FOR MBE AND OTHER SEMICONDUCTOR TECHNOLOGIES
NEW METHOD OF PURIFICATION AND PREPARATION**
particularly effective for removal of oxygen and metallic contaminants

RESULTS OF ANALYSES by the spark source mass spectrometry (in ppm):

Li < 0.02	Na ≈ 0.1 ± 0.05	P < 0.03	K ≈ 0.1 ± 0.05	Fe ≈ 0.1 ± 0.05
B < 0.02	Al ≈ 0.25 ± 0.05	S ≈ 0.07 ± 0.03	Ca ≈ 0.1 ± 0.05	Cu < 0.05
F < 0.03	Si ≈ 0.2 ± 0.1	Cl < 0.05	Mn < 0.05	Zn ≈ 0.2 ÷ 0.8

Available Products:

- **Pieces** ≈(10 x 20, 10 x 10, 10 x 5, ...) mm^2 plates, about 1-2 mm thick cut into pieces from bigger plates (see photograph)
- **Ingots** ϕ10 — 10÷25 mm length (see photograph)
  ϕ15, ϕ20 mm, and ϕ 25mm — 20÷30 mm length (see photograph)
- **Targets** ϕ = 25,4mm (1 inch) — 3÷10 mm thickness (see photograph)
  ϕ = 50,8mm (2 inches) — 1,0÷1,6 mm thickness (see photograph)

Note that the density of Mg is 1.7 g/cm^3

DELIVERY TIME for all products: 2-3 weeks.
Note: a number of pieces (≈ 10÷20 g) are always in store, ready to dispatch immediately

ALL PRODUCTS are vacuum packed in glass ampoules to prevent oxidation

CONTACT: Prof. Andrzej MYCIELSKI
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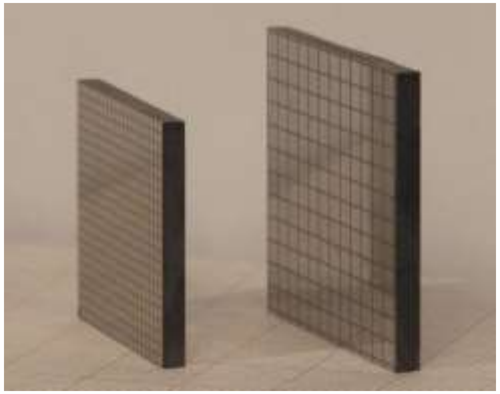
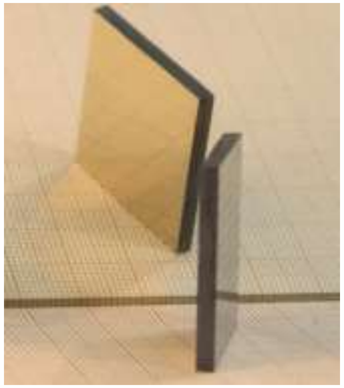
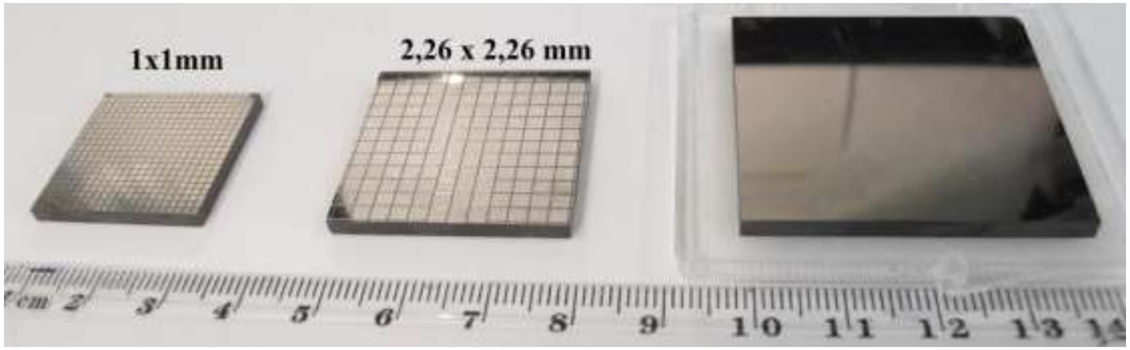
(Cd,Mn)Te crystals for X-ray and gamma-ray detectors





Pixels 2,46 × 2,46 mm² for nuclear medicine.
Pixels 1,1 × 1,5 mm² for measuring of density of osteoporotic bones.
Pixels 1,0 × 1,0 mm² for computer tomography.

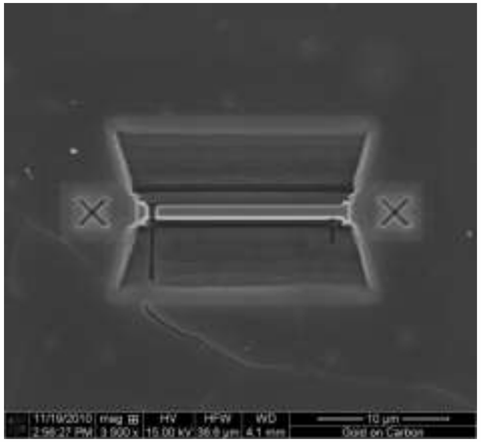


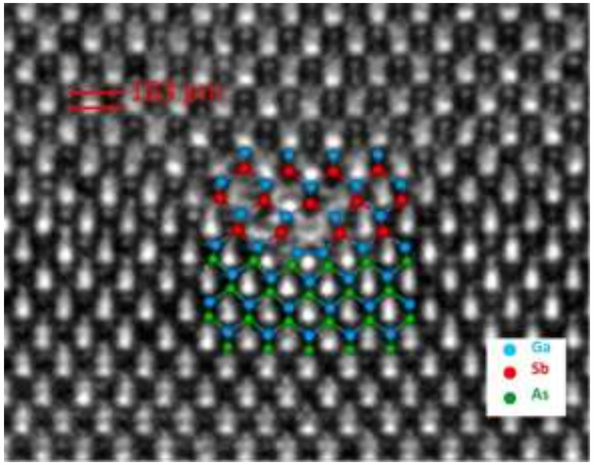
Characterization of new materials

➢ *Determination of crystal structure and crystallographic defects by high resolution X-ray diffraction systems*

Transmission Electron Microscope Titan 80-300, Helios – NanoLab 600

- *Determination of crystal structure in nanoscale*
- *Investigation of crystallographic defects*





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Patent Applications in 2013

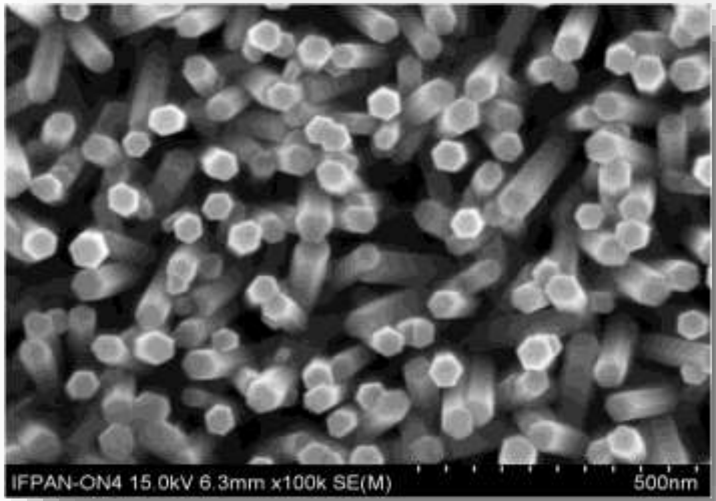
Lp.	Title	Date	No	Country
1	Hydrothermal method of production of ZnO nanorods	13.02.2013 r.	P.402753	Poland
2	Hydrothermal method of production of oriented ZnO nanorods	13.02.2013 r.	P.402754	Poland
3	P-i-n structure of UV detector and way of its production	12.04.2013 r.	P.403520	Poland
4	Way of production of substrates with nanocoatings with a developed surface	15.05.2013 r.	P.403897	Poland
5	Way of production of antireflection coating on a transparent substrate and multilayer antireflection film	11.06.2013 r.	P.404291	Poland
6	Structure of UV detector and way of its production	11.07.2013	P.404645	Poland
7	Method of preparation and a device for obtaining semiconductors with homogeneous hydrogen concentration	08.11.2013 r.	P.405990	Poland

Patents in 2013

Lp.	Title	Date	No	Country
1	Method of preparation of undoped n-type lead sulfide	06.11.2013 r.	P.392848	Poland
2	Method and a device for preparation of polycrystalline semiconductor compounds	05.11.2013 r.	P.389480	Poland
3	Method of preparation of layered nanocomposite thermoelectric material	19.06.2013 r.	P.391233	Poland
4	Detector of X-rays and gamma-rays	31.07.2013 r.	P.381438	Poland
5	Method of preparation of semiconductor n-(Eu,Gd)Te/p-PbTe heterostructures and a heterostructure for generation of random numbers	15.04.2013 r.	P.383757	Poland
6	Method of fabrication of semiconducting zinc oxide layers	06.07.2013 r.	P.384127	Poland
7	Thermoluminescence Detector	01.09.2013 r.	P.388778	Poland

Patents in 2012 – 2014 (WP5)

	2012	2013	2014
Patents	4	7	12



Nanowires ZnO obtained in the Group of prof. Marek Godlewski

Scientific Prizes in 2005 – 2013

- Agilent Technologies Europhysics Prize

Professor Tomasz Dietl – 2005

- Prize of the Foundation for Polish Science

Professor Tomasz Dietl – 2005
Professor Andrzej Sobolewski – 2007

- Copernicus - 2008
Prize of the Foundation for Polish Science and Deutsche Forschungsgemeinschaft (DFG)

Professor Andrzej Sobolewski
Professor Wolfgang Domcke

- Smoluchowski - Warburg Prize
Prize of the Polish and German Physical Societies

Professor Andrzej Sobolewski – 2009

Scientific Prizes in 2005 – 2013, CNT.

- Siemens Research Prize 2008

Professor Andrzej Mycielski

For the achievements in: „Development of a method of purification and production of ultrapure (6N) elements: Manganese (Mn), Magnesium (Mg), and other selected semiconducting compounds for advanced technologies and applications".

- Stefan Pieńkowski Prize of the Polish Academy of Sciences

Dr Piotr Deuar - 2010
Dr Michał Matuszewski - 2011
Dr Łukasz Cywiński - 2013

-The Prize of the Minister of Science and Higher Education

Professor Tomasz Wojtowicz - 2013

Professor Maciej Kolwas

President of the European Physical Society

2009-2011

Professor Tomasz Dietl

was elected a member

of the Steering Committee

of the European Research Council - 2012

Technological Prizes in 2014 (WP5)

The Belgian and International Trade Fair for Technological Innovation
Innova 2014, Brussels

Gold Medal with mention for the innovation: *Innovative antibacterial coating*
Silver Medals for the innovation*:*
Ultra-sensitive UV radiation detector
Innovative photovoltaiccell based on nanorods and ZnO layers

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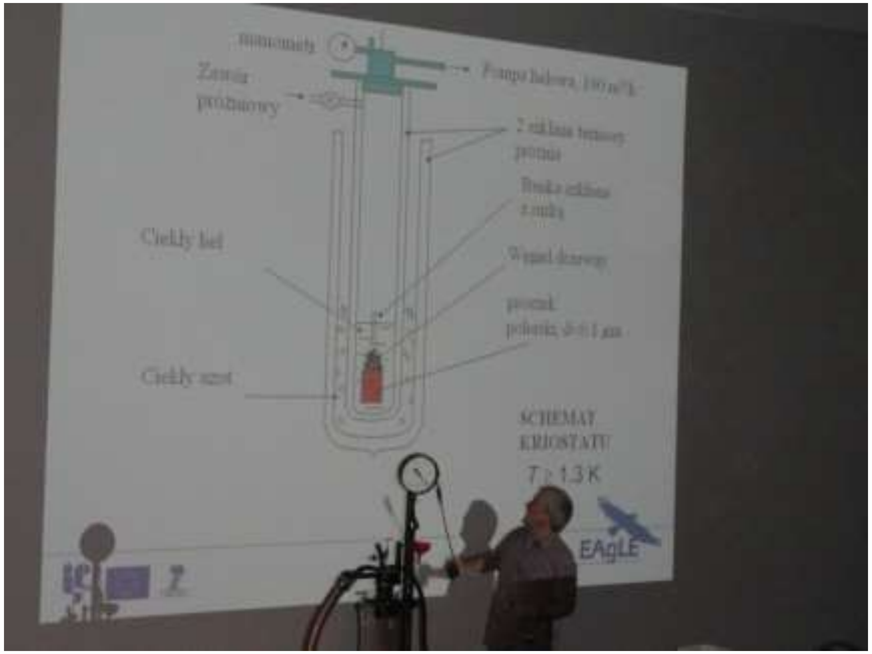
Promotion via mass media, popularization of science (WP6)

18th Warsaw Science Festival (in 2014)



Prof. Grzegorz Grabecki explains the “fountain effect” in superfluid helium

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