ヴィシェグラード4カ国×日本　技術移転セミナー

産業化のためのナノ材料

開催: 2016年6月16日（木）
時間: 13:30 – 19:00（開場 13:00）

会場:　駐日チェコ共和国大使館
（東京都渋谷区広尾2-16-14）
言語:　英語
定員:　80名

T A

Č R

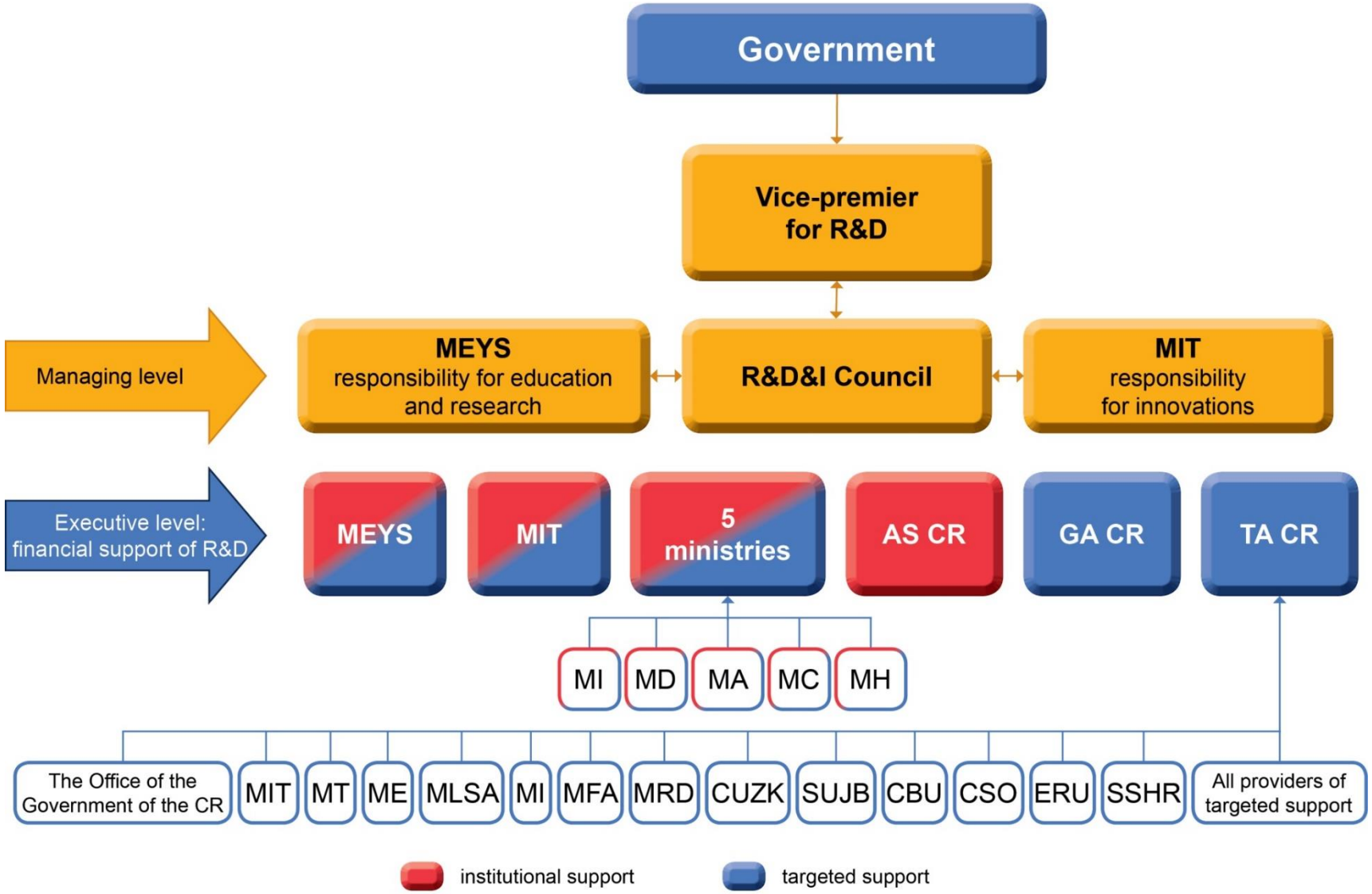
... research useful to society

Technology Agency
of the Czech Republic
and its place in the R&D system of the CR

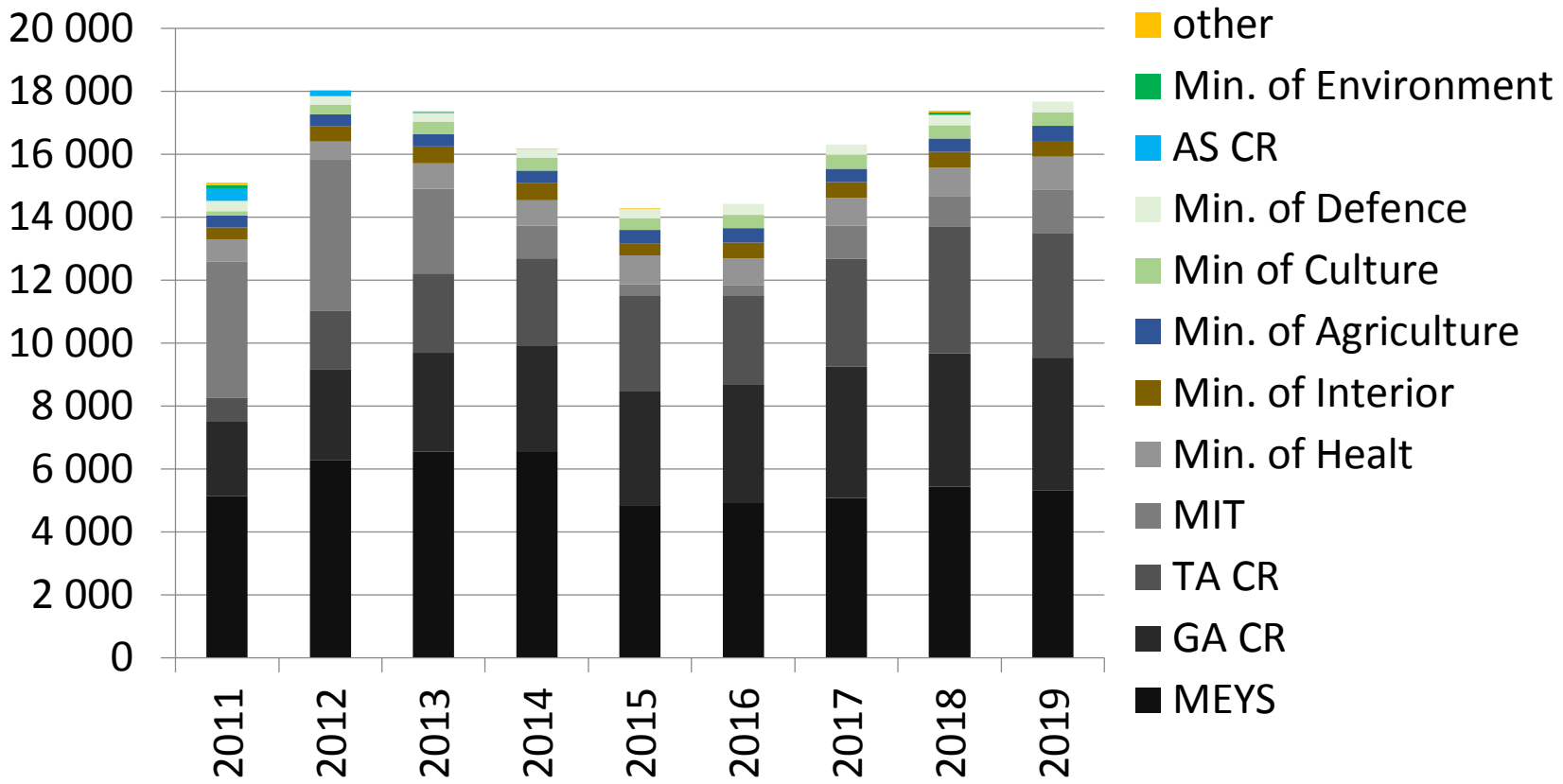
Tokio, Japan

7th June 2016

Management of R&D System in the CR



Targeted support for all providers 2013-2019



Source: until 2016 R&D&I Council, 2016 – State budget; since 2017 according to the R&D&I Council suggestion; including new programmes; MIT and MEYS 2016 – 2019 without cofinancing of EU funds; MEYS including the National Sustainability Programme I and II;

TA CR
Objectives

- To support the applied research, experimental development and innovation in the CR
- To support the cooperation and communication between research organizations and the private sector
- To reduce the fragmentation of targeted support in the CR
- To contribute to increasing the competitiveness and the economic growth of the CR

TA CR
Tasks and Activities

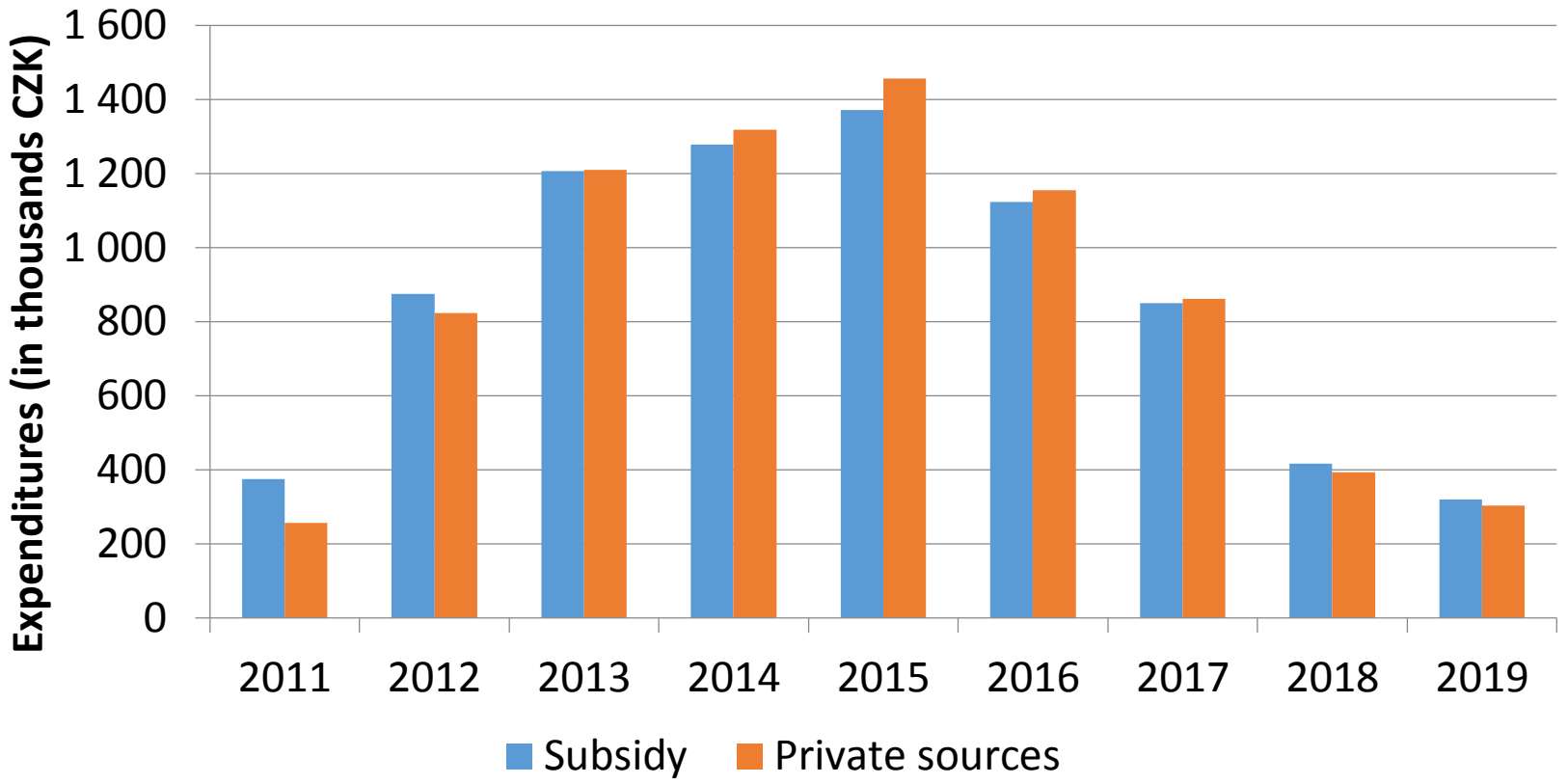
- The preparation and implementation of programs of applied research, development and innovation
- Comprehensive project management (project selection, monitoring of the performance, evaluation of outputs)
- Providing the targeted support from the state budget
- Consultancy to researchers and users of project results especially in the legal field, financial field and in the field of protection of intellectual property
- Collaboration with ministries that ensure applied research, development and innovation, and similar agencies – both domestic and foreign

TA CR
Organizational Structure

Three “Pillars”:

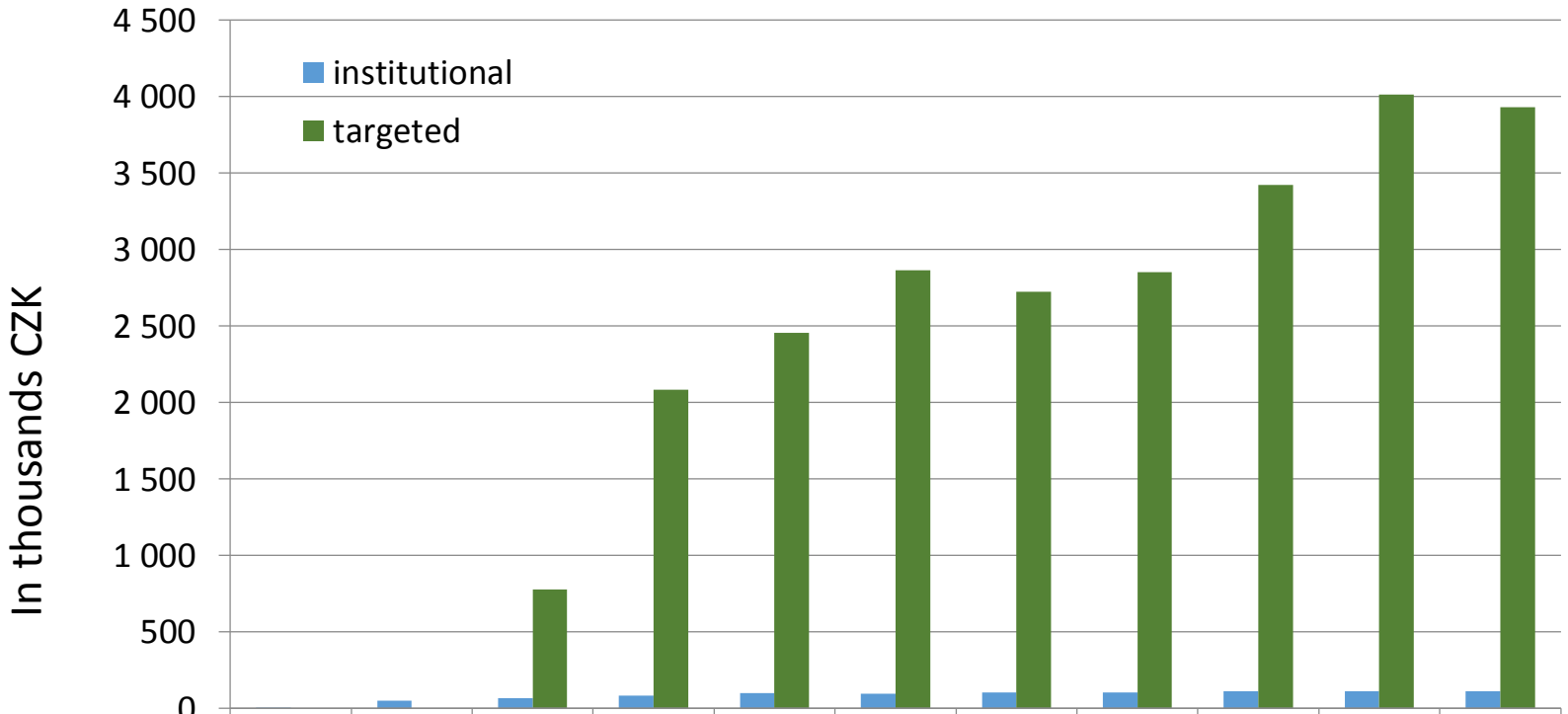
- Chairperson of TA CR
  - ...and the Executive Board of TA CR, 5 members
  - the “Office” of TA CR
    - management of programs, data, evaluation, information, PR, ...
- Research Board of TA CR (Advisory/strategic)
- Compliance and Redress Committee of TA CR
  - Independent body for handling complaints and reviewing TA CR’s procedures, appointed by the Parliament

Funding and private sources of private entities in projects supported by TA CR



Paid and commited resources, as of 31st December 2015

TA CR budget



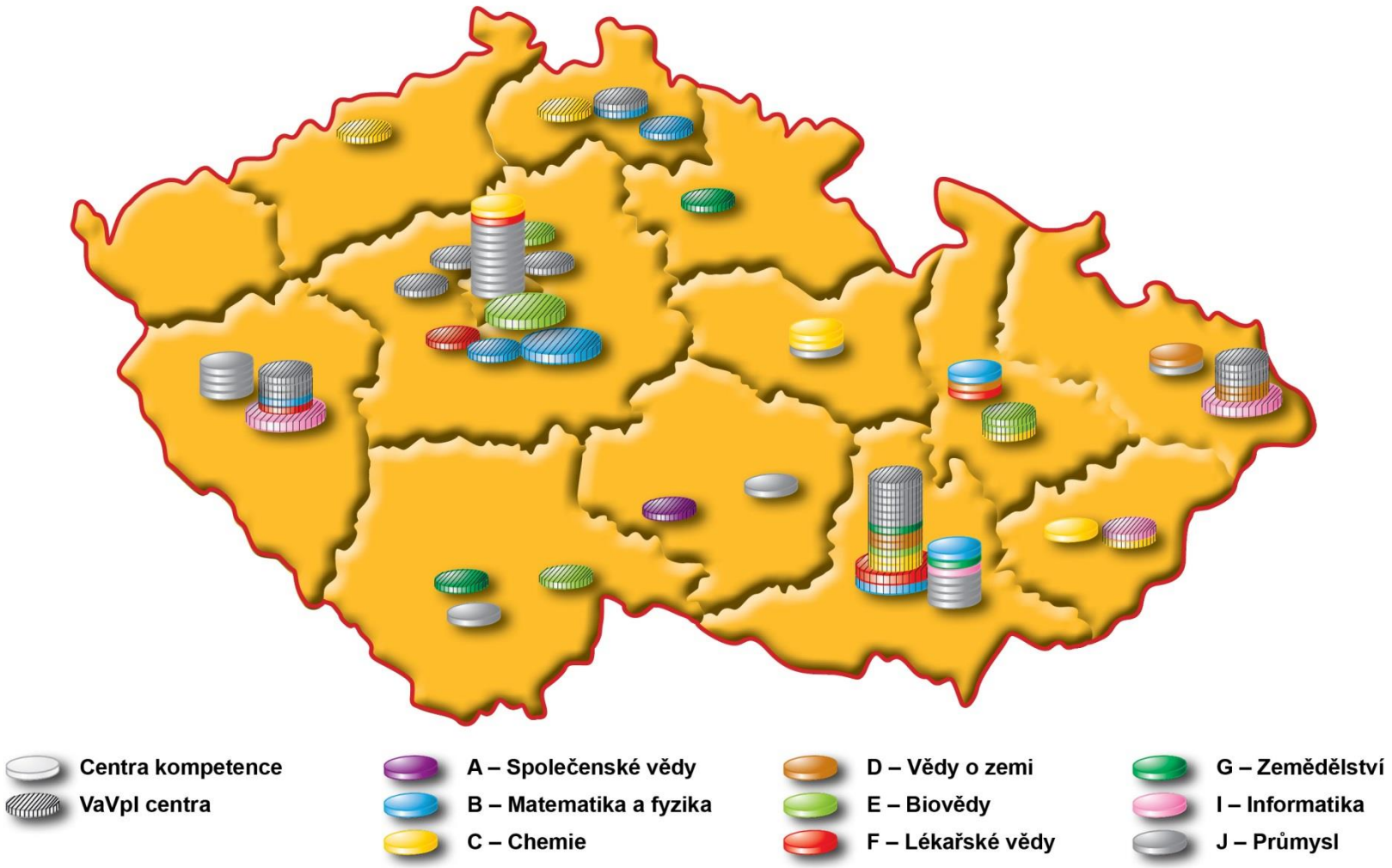
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
institutional	2,4	52,0	69,4	84,4	99,0	98,1	106,4	106,4	114,4	114,4	114,4
targeted	0,0	0,0	780,1	2 085,8	2 457,5	2 864,4	2 725,3	2 852,5	3 424,5	4 014,5	3 930,1

Zdroj: RVVI

TA CR programmes

- **ALPHA** – searching for “smart solutions“ in areas of progressive technologies, sustainable transportation and protection of the environment
- **BETA/2** – public procurement in R&D for the needs of public administration bodies
- **OMEGA** – searching for “smart solutions“ in the field of applied social sciences
- **Competence Centres** – support for a long-time and sustainable collaboration between research organizations and companies working on a dedicated research agenda
- **EPSILON** – replaces program ALPHA, based on ministerial strategies and National priorities of applied research
- **GAMMA** – support for the commercialization of outputs of applied research and development
- **DELTA** – support of international collaboration in applied R&D
- **ZETA** - promotion of equalization of opportunities for young researchers - men and women - when solving applied research projects.

R&D&I Infrastructures (OP RDI & TA CR CC)



Newly prepared programmes

- **ETA –** follows the programme OMEGA, prepared on the basis of roundtables with experts on social sciences and humanities, and in cooperation with the Ministry of Culture and other ministries, aims to promote the involvement of social sciences and humanities into R&D projects that are beneficial for maintaining and improving the quality of human life and response to dynamic social, economic, globalizational, cultural or technological changes;
- **THETA –** R&D support in the energy sector with a focus on securing state supervision of nuclear safety, new technologies and long-term technical perspective, prepared in collaboration with the MIT, MEYS, SONS and ERO;
- **National Competence Centres -** will be focused on linking existing centers of excellence for research, development and innovation (eg. Competence centers, European centers of excellence and regional research and development centers) into larger units, which will significantly contribute to the development of competitiveness of the country.

Projects supported by TA CR* (As of 18th May 2016)

Programme	ALPHA	CC	DELTA	EPSILON	GAMMA	OMEGA	Total
Submitted	3 501	210	27	725	55	650	5 168
Supported	961	34	4	88	21	194	1 302
Success rate	27,4	16,2	14,8	12,1	38,2	29,8	25,2
supported:							
costs (in ths. CZK)	14 387 439	9 025 843	63 789	1 420 774	410 703	469 814	25 778 360
support (in ths. CZK)	9 252 356	6 146 045	45 880	863 038	410 703	367 567	17 085 589
Support rate	64,3	68,1	71,9	60,7	100,0	78,2	66,3

** Without 2nd call of the DELTA programme.*

Source: TA CR

Structure and number of participants in projects supported by TA CR* (As of 18th May 2016)

Organization type	Size/type of organization	Number of participations	Funding (in ths. CZK)
Enterprises	**Total**	**1 717**	**7 807 491**
	Small enterprises	706	2 559 889
	Medium enterprises	424	2 038 511
	Large enterprises	587	3 209 091
Research organizations	**Total**	**1 723**	**9 278 098**
	Public universities	1 068	6 100 486
	AS CR	217	1 255 743
	Other public ROs	205	673 883
	Other ROs	233	1 247 986
Total		**3 440**	**17 085 589**

** Without 2nd DELTA call.*

Source: TA CR

Supported project and CEP categories*

CEP category	Supported projects	Funding (in ths. CZK)
Industry	614	10 035 376
Social sciences	190	488 498
Sciences about the Earth	167	1 605 200
Agriculture	87	799 354
Mathematics and Physics	59	1 077 617
Chemistry	58	1 189 539
Medical science	48	948 270
Biosciences	47	554 677
Informatics	32	387 059
Military	0	0
Total	**1 302**	**17 085 589**

** Without 2nd DELTA call.*

INKA Project

- **Setting up a methodology for mapping the innovation potential of the CR,** that will be sustainable and will enable comparison of data over time

- A unique combination of data (MAE, MIE) and of primary data from structured interviews (in companies nad ROs)

- **Min. of Industry and Trade, MEYS and Min. of Labour and Social Affairs = project partners;** other ministries and the Office of the Government of CR are kept informed (20th January 2015 – seminar for the conclusion of Phase 1)

International collaboration of TA CR

- One of the tasks specified in the law (130/2002)
- TAFTIE
- Program DELTA

Taftie
The European Network of Innovation Agencies

Delta

DELTA Programme
Basic information

“Programme for the support of applied research and experimental development through joint projects of technology and innovation agencies“

Support of joint projects of enterprises and research organizations supported by TA CR and leading foreign technology and innovation (or similar) agencies with which, by the time of the call for proposals, TA CR has/will have initiated a cooperation

-> Memorandum of Understanding is a desired form of cooperation agreement

DELTA Programme
Basic information

- Programme is not thematically focused;

- Topics of joint projects will be set ad hoc
  - Areas, in which projects will be accepted, may differ not only per each partner agency, but also per each call for proposals;

- The aim of the programme is:
  - To increase number of real R&D outputs in areas for which there is a consent of both TA CR and foreign partner,
  - which will be successfully embodied in the practice and thus will contribute to the competitiveness of the Czech Republic – doing this by supporting bilateral or multilateral cooperation.

DELTA Programme
Programme Characteristics

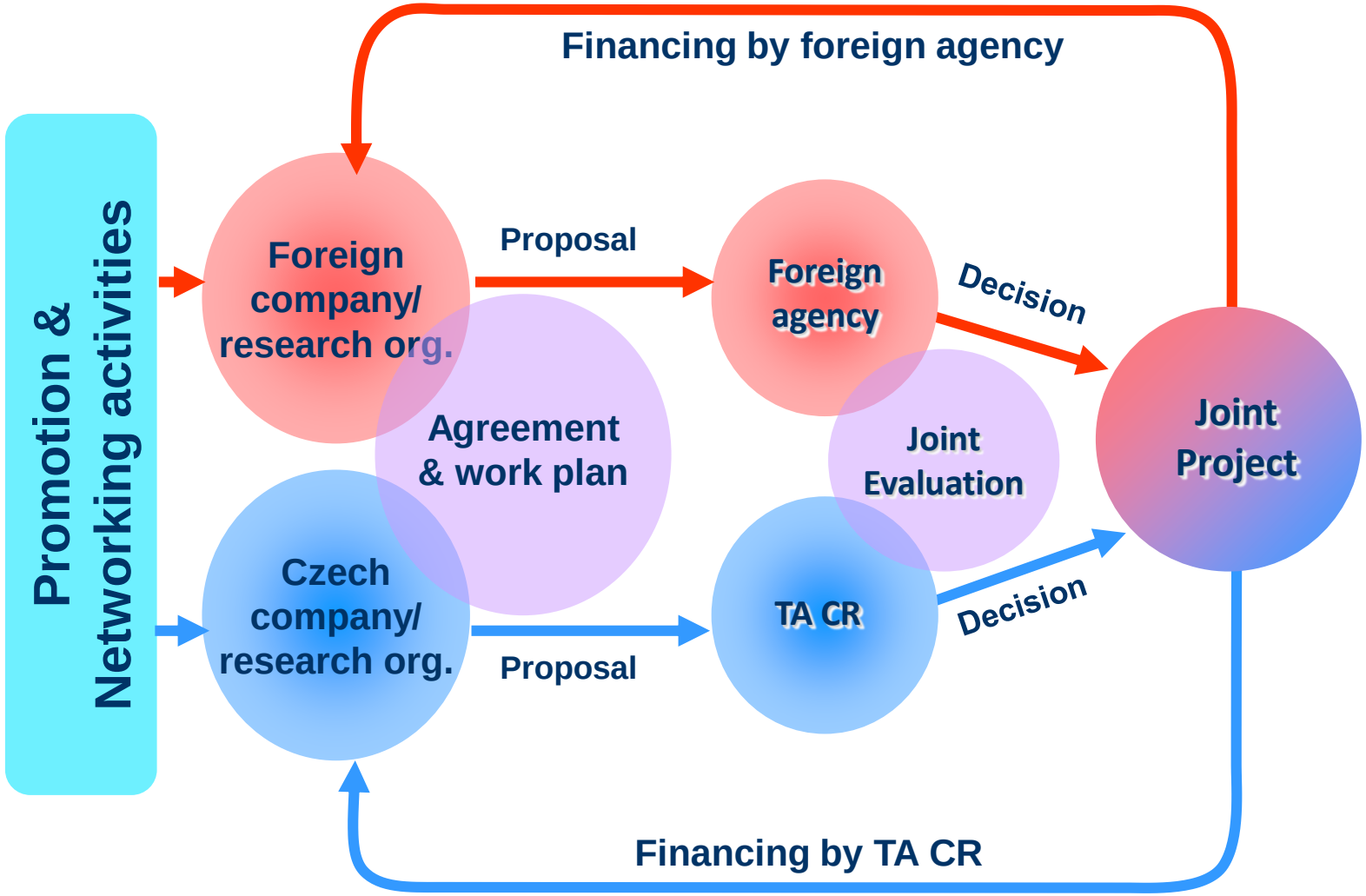
- Not a classic programme – it requires:
  - Active creation of conditions for a successful implementation of the programme – maximal facilitation of a match-making of Czech and foreign institutions, otherwise there will not be enough projects applying.
  - As flexible conditions as possible.

- Need for securing a service for a IPR protection – TA CR will have to be an active partner for the beneficiaries.

- Non-European states are the priority.

- On the Czech side either companies, or companies + Research organisations.

DELTA Programme
Financing Scheme



DELTA Programme
Calls for Proposals

Call for proposals	Date of the launch of the call	Results of the call published	Number of project proposals submitted	Projects supported	Success rate
TF1 (Vietnam)	9.6.2014	19.12.2014	27	4	14,8%
TF2 (Jiangsu, Zhejiang, Sichuan, Taiwan)	13.7.2015	21.12.2015	26	13	50,0%
TF3 (Korea)	27.4.2016	31.10.2016	?	?	?

Thank you for your attention.

Web: www.tacr.cz

Facebook: http://www.facebook.com/tacr.cz

LinkedIN: http://www.linkedin.com/company/technologick-agentura-esk-republiky
Twitter TA CR: http://twitter.com/TACR_cz

YouTube: https://www.youtube.com/channel/UC1arGrQjwIKbQGDrpIB-n0A

Google+: http://plus.google.com/u/0/b/105572200316564197586/105572200316564197586/posts

The National Centre
for Research and Development

NCBR

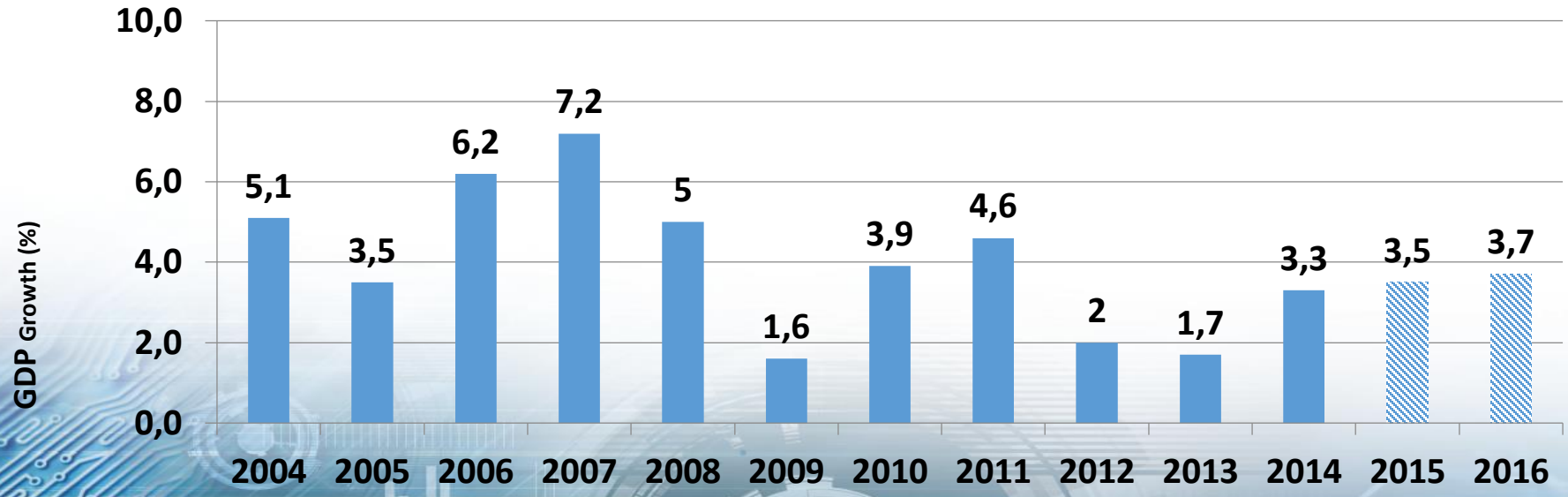
Research Funding Schemes

NCBR.gov.pl

Agnieszka Ratajczak
Head of Unit, International Programmes
Programme Management Departemnt

Positive trends in key economic indicators – GDP, debt

- POLAND - **the fastest growing EU economy in 2004-2014 (6th largest in the EU)**
- it had grown twofold (from 192 bn euro in 2004 to 413 bn euro in 2014, according to Eurostat)
- **general government gross debt in Poland is relatively small (50%)**; Greece (177%), Italy (132%), Portugal (130%), Ireland (110%)

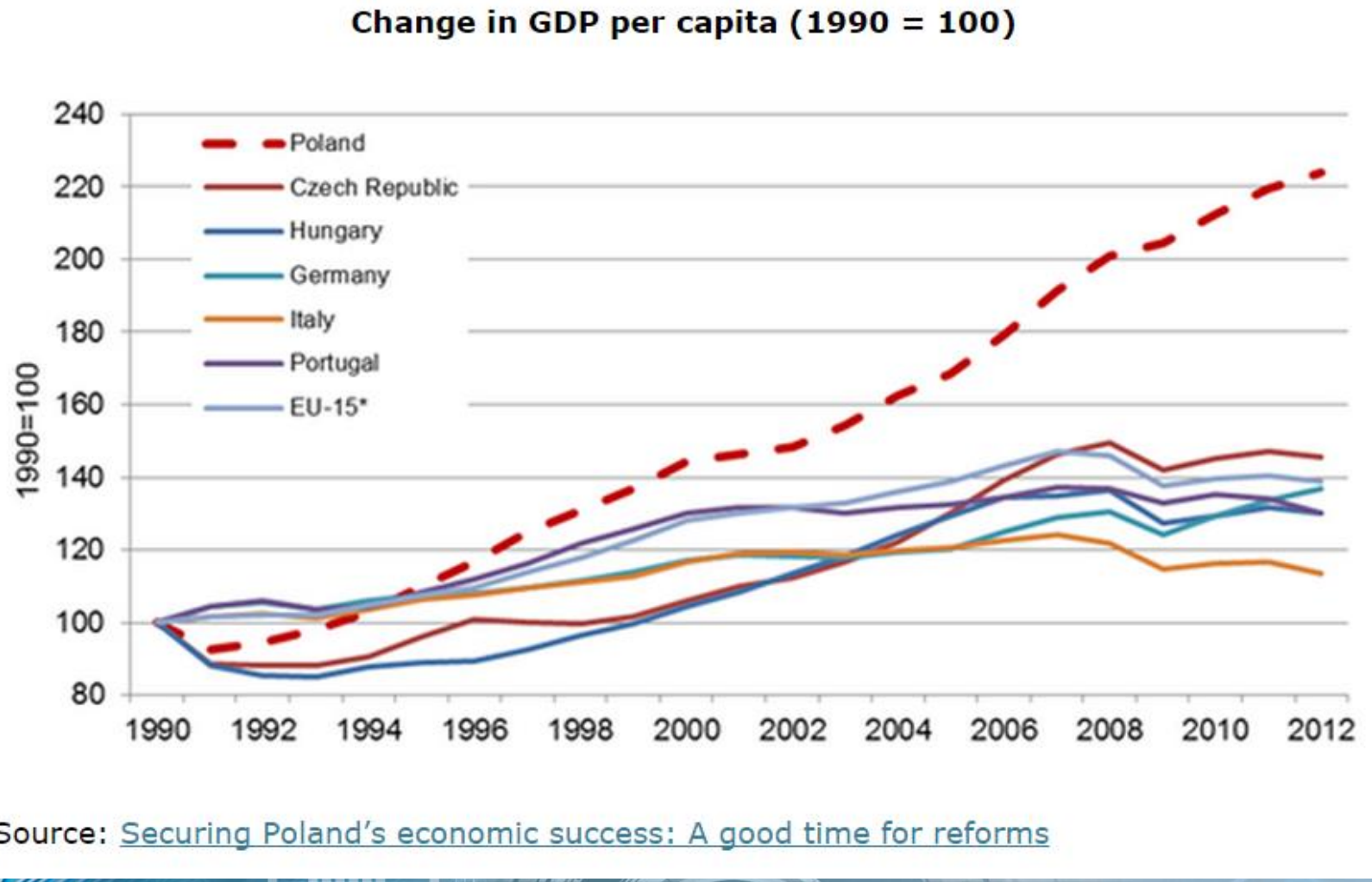


Source: Eurostat, International Monetary Fund - the forecasted values for 2015 and 2016

Positive trends in key economic indicators

GDP per capita 25% (2004) → 40% (2013)

GDP **Purchasing Power Standards** 49% (2004) → 67% (2013)



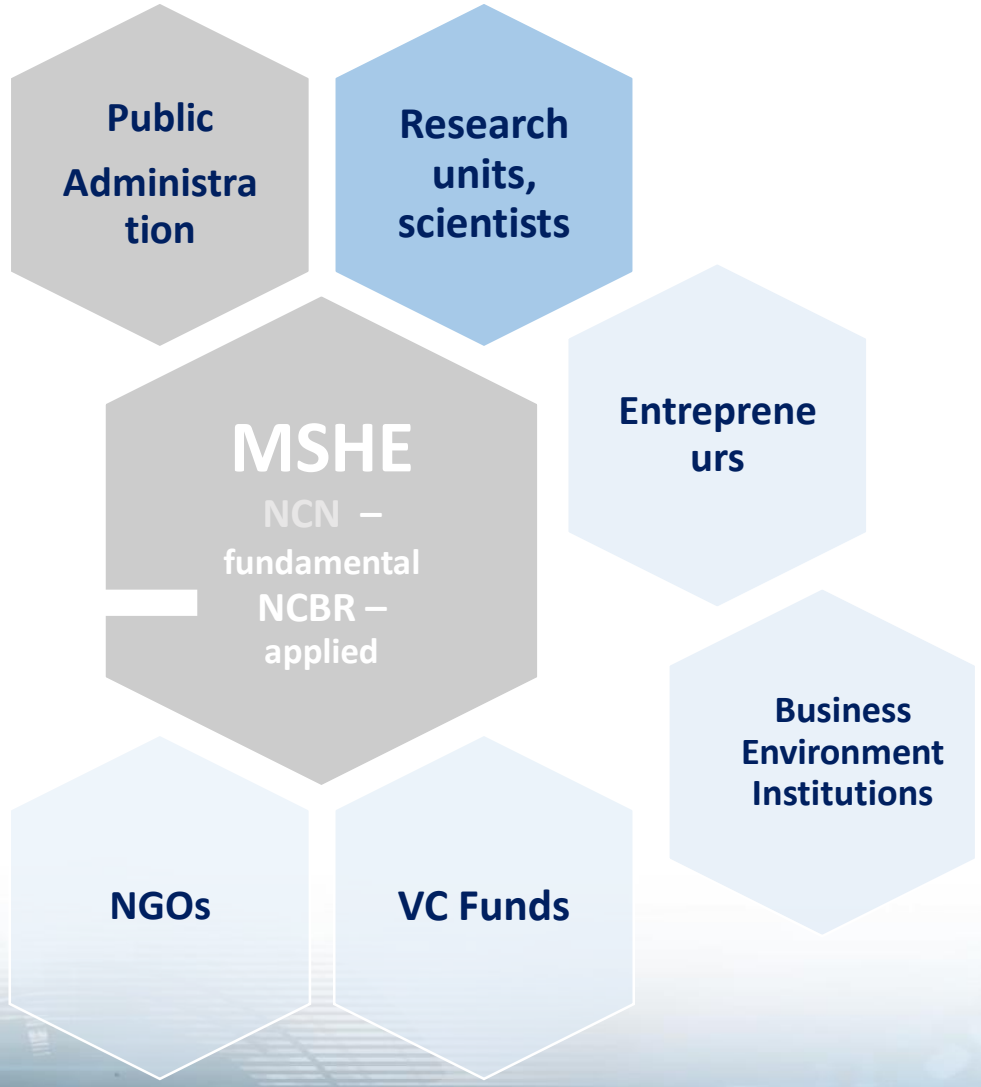
Source: Securing Poland's economic success: A good time for reforms

Financial Perspective 2014-2020

- Financial perspective 2014-2020 is a chance for Poland to become a **knowledge-based economy**.
- **82,5 bn EUR** from cohesion policy budget, out of which **76,9 bn EUR** dedicated for Operational and Regional Programmes.
- Over **7 bn EUR for NCBR**, including **6 bn EUR – OP Smart Growth** (priority I - Support of innovation in enterprises and priority IV - Increasing R&D potential).

NCBR in the system of R&D financing

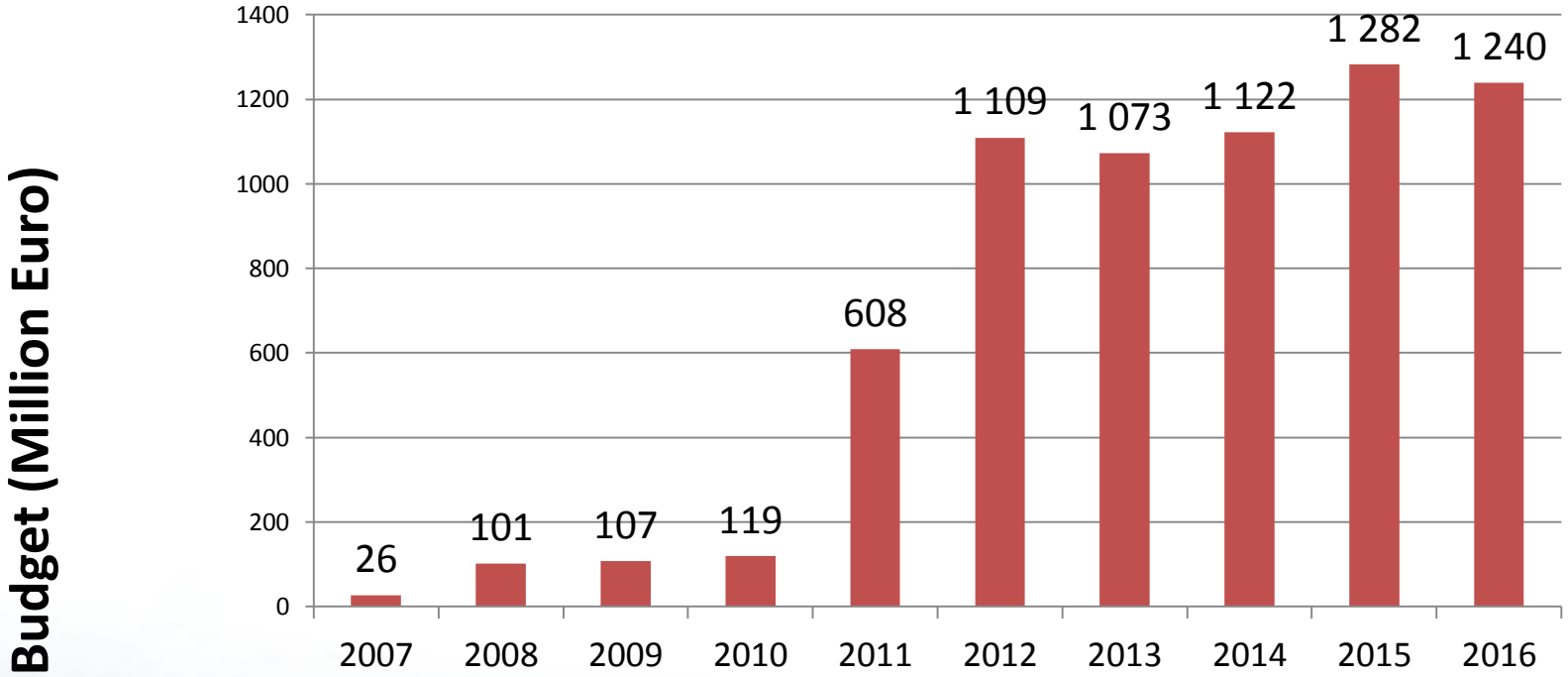
- Executive agency supervised by the Minister of Science and Higher Education (MSHE)
- Established in 2007 to perform tasks related to science, technology and innovation policies adopted by the Polish government
- The Act on National Centre for Research and Development dated 30 April 2010 (Journal of Laws from 2010, No. 96 item 616)



NCBR's mission & tasks

- Support of **sustainable economic growth** through the use of R&D results
- **Applied research financing**
- Facilitation of **science-business cooperation**
- Support of **commercialisation** **transfer of scientific research results**
- **International cooperation**
- Facilitation of career development of **young scientists**
- Managing applied research programmes and national **security and defense**

NCBR's budget



Source: NCBR

Rules of funding

- **Competitive calls for proposals -** projects selected on the basis of peer review (foreign reviewers)
- **Applicants –** R&D organisations (public and non-public), enterprises, consortia of research organisations and enterprises
- **Key criteria for project selection –** applicability of R&D results, scientific value, quality/capacity of the applicants
- **Funding –** research organisations: up to 100% of eligible costs, enterprises (depending on their size and activity performed): from 25% up to 80% of eligible costs
- **NCBR funding** – available only for entities registered and operating in Poland, foreign entities may participate as a subcontractor
- **Intellectual Property Rights** - ownership is subject to consortium agreement or agreement on IPR. Basically all rights are granted to consortium unless NCBR ex ante sets different rules.

Funding of foreign researchers

- **National calls for proposals:**
  - ✓ Foreign researchers employed by Polish institutions
  - ✓ Foreign intitutions as subcontractors of reseach task
  - ✓ Foreign institutions as non-funding partners

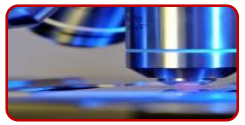
- **International bilateral calls:**
  - ✓ Funding provided by national funding institutions

National Research Programme – Strategic Programmes

New energy technologies → Advanced Technologies for Energy Generation

Diseases of affluence, new medicines and regenerative medicine → STRATEGMED launched in 2013

High IT technologies and mechatronic technologies



New material technologies → TECHMATSTRATEG to be launched in 2016

Environment, agriculture, forestry → BIOSTRATEG launched in 2014

Social and economic development of Poland in the context of globalization

Security and defence → Since 2011 NCBR takes actions related to scientific research and studies for the purposes of national defense and security

Strategic Programmes

- Objective: to achieve significant progress in the treatment of civilisation diseases and in regenerative medicine in the following areas: cardiology and cardiac surgery, oncology, neurology and senses.
- 3 Calls – total budget allocation 174 M Euro

BIOSTRATEG

- Objective: to achieve significant progress in the development of knowledge and implementation of innovative technologies in rational management of natural resources, forestry, agriculture.
- 2 Calls – total budget allocation 87,5 M Euro

TECHMATSTRATEG

- Objective: programme dedicated to advanced material technologies.
- Programme allocation: ~ 125 M Euro
- First call in 2016 (first quarter)

Sectoral Programmes

- Polish Aeronautical Technology Platform
- **Objective:** to increase competitiveness of Polish economy in the field of high-tech products for aeronautical sector

INNOMED

- Polish Technology Platform for Innovative Medicine
- **Objective:** to increase competitiveness of Polish medical technologies and improve access to advanced medical products
- 1 call for proposlas/ allocation: ~ **24 M Euro** **(95 M PLN)**

INNNCHEM, INNOSTAL, GAMEINN, INNOSBZ

Programme budget: 50 – 150 M Euro

LIDER Programme

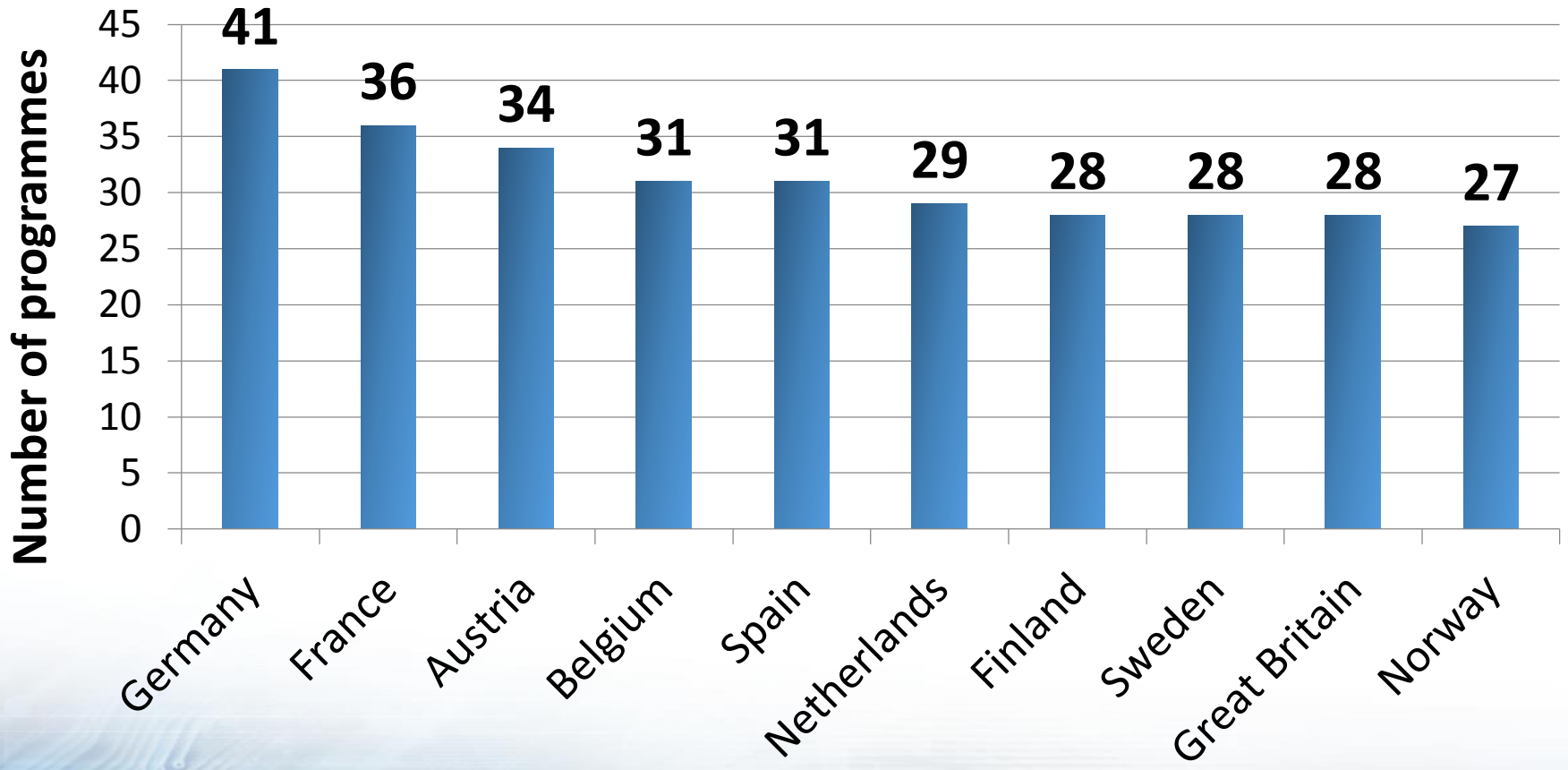
Dedicated to young scientists with the aim to develop managerial and leadership skills (building a rearch team and building and runnning the research project).

- projects with application potential
- for young scientists – up to 35 years of age, holding master/PhD degree
- has published in reviewed scientific journals/ holds a patent
- aquire a reaserch inistitution which will provide a contract for the leader and his/her stafff
- has a Polish citizenship or residential permit (easiliy aquired for research staff, based on a contract with a Polish institution)
- funding up to EUR 300 th/project

Types of International Programmes

- **Polish-Norwegian Research Programme**
- **Bilateral cooperation**
- **Multilateral cooperation** (V4 + Japan; V4 + South Korea)
- **Cooperation within ERA-NET, ERA-NET PLUS, ERA-NET COFUND, ERANet-LAC: Latin America, Caribbean and European Union, SEA-EU-NET** (more than 20 initiatives)
- **Network cooperation** (CORNET, ERA Chemistry, ERA-NET BIOENERGY, FENCO)
- **Joint Programming Initiatives** (JPI AMR, JPI HDHL BioNH, JPND, FACCE JPI, JPI HDHL DEDIPAC KH)
- **Joint Undertakings** (ARTEMIS, CLEAN SKY, ECSEL JU, ENIAC, IMI JU)
- **Other international initiatives** (AAL, BONUS-185, EUREKA, EuroSTARS)

Our Key Foreign Partners



Source: NCBR

Bilateral Cooperation

- **Bilateral Cooperation based on MOU** - Berlin, the Czech Republic, Germany, Israel, Japan, Luxembourg, Norway, Singapore, Taiwan, Turkey, South Africa, Brazil

Country/partner	No of projects	Grant value (~ M Euro)
Norway	75	68.5
Taiwan	20	2.0
Israel	9	3.1
Germany	9	6.3
Luxembourg	6	2.0
Berlin	4	2.1
Japan	2	0.2
Turkey	5	1.1
RPA	6	0.5

Asia and South Pacific Cooperation

Bilateral Agreements:

- Poland-Taiwan (MOST): materials science, neuroscience, Energy, environment
- Ponad-Japan (JCOAL): conventional (coal and lignate-based) energy generation
- Poland-Singapore (ASTAR)

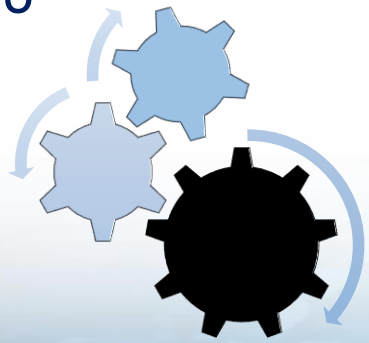
Multilateral Agreements:

- SEA-EU-Net (Southeast Asia and Europe): health, environment, food
- V4-Japan (Visegrad Group and Japan): materials science
- V4-South Korea (Visegrad Group and South Korea): materials science

Summary

NCBR

- **is implementing new mechanisms of cooperation** where industry sectors have a decisive voice about scope of R&D works.
- **is introducing innovative financial instruments**
- **is testing and implementing new mechanisms** in order to better facilitate science-business cooperation.
- NCBR has signed more than 5 500 agreements for **over 7 bn euro**



The National Centre
for Research and Development

Thank you
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RESEARCH, DEVELOPMENT AND INNOVATION IN HUNGARY

STRUCTURE AND FUNDING

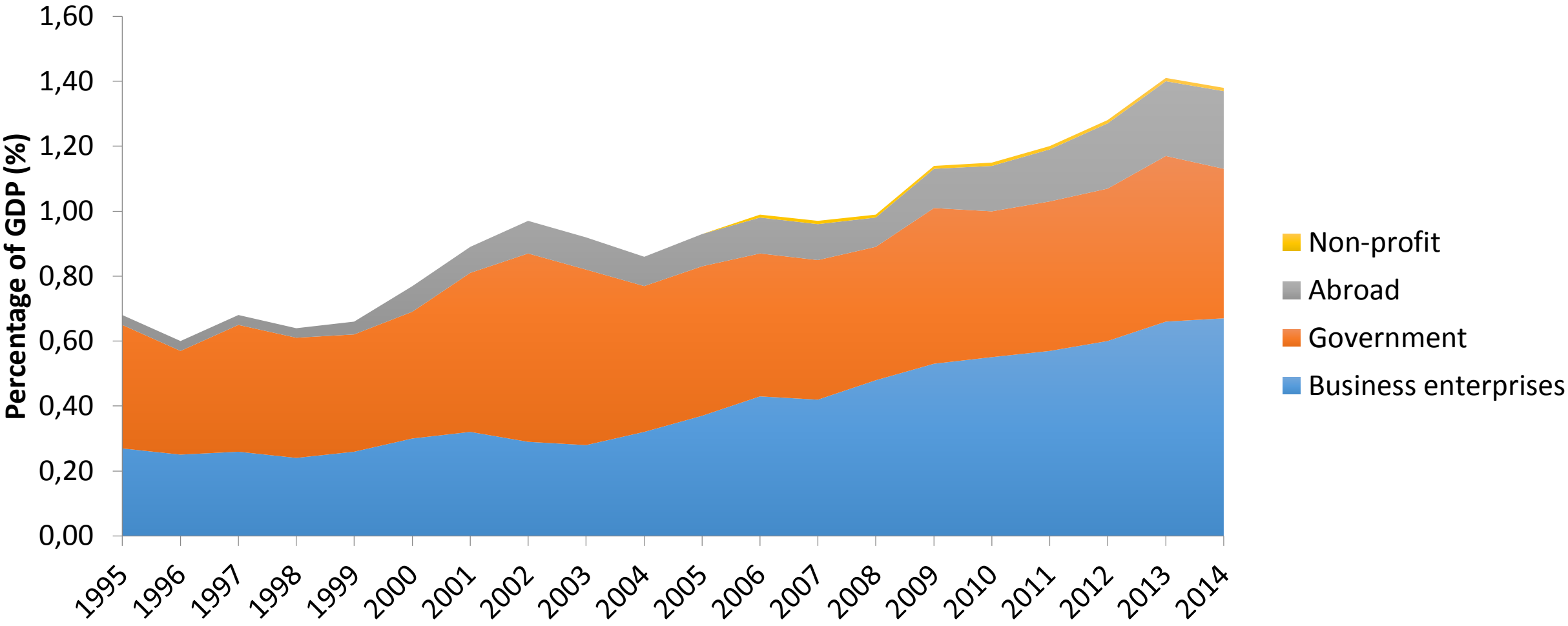
シゲティ ギュラ ピーター

Gyula Peter Szigeti

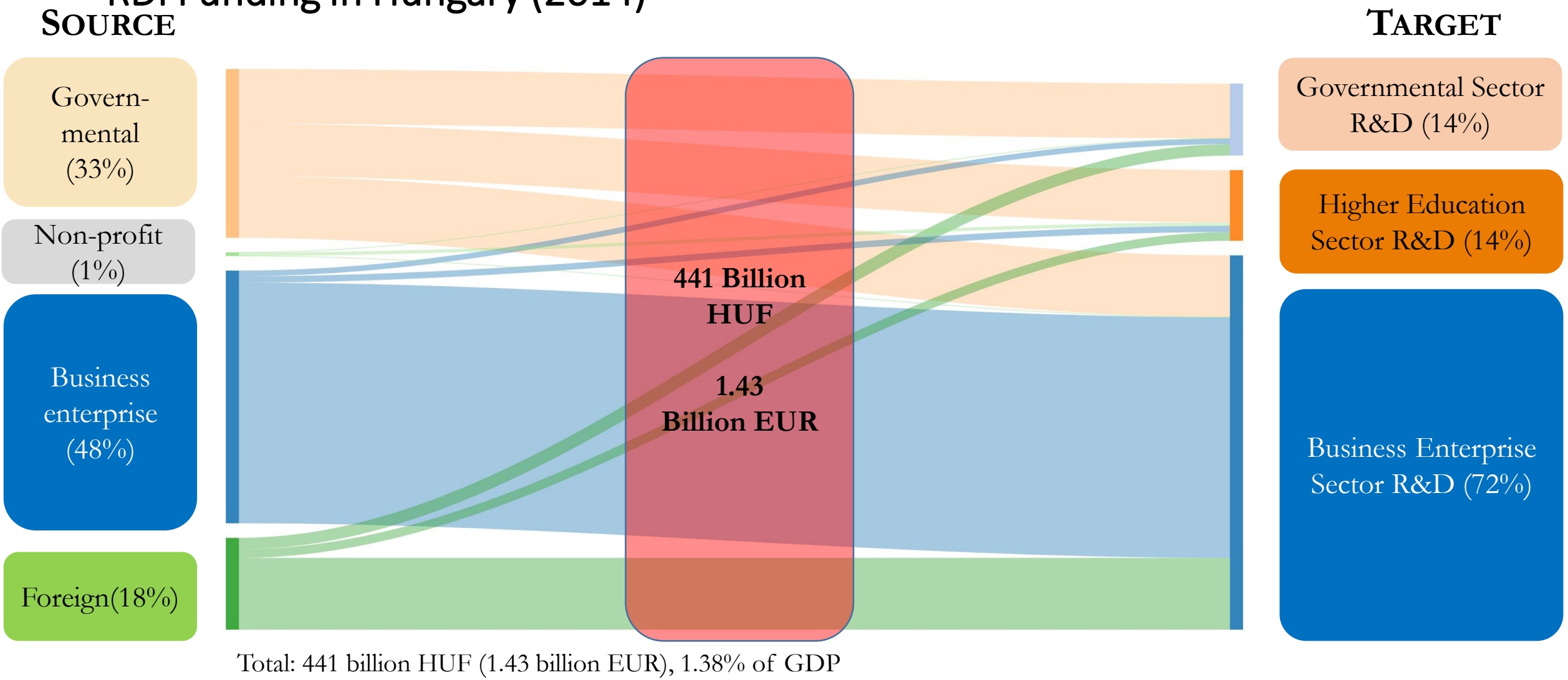
National Research, Development and Innovation Office

Tokyo, Japan – 16-06-2016

Sources of RDI expenditure in Hungary (% of GDP)

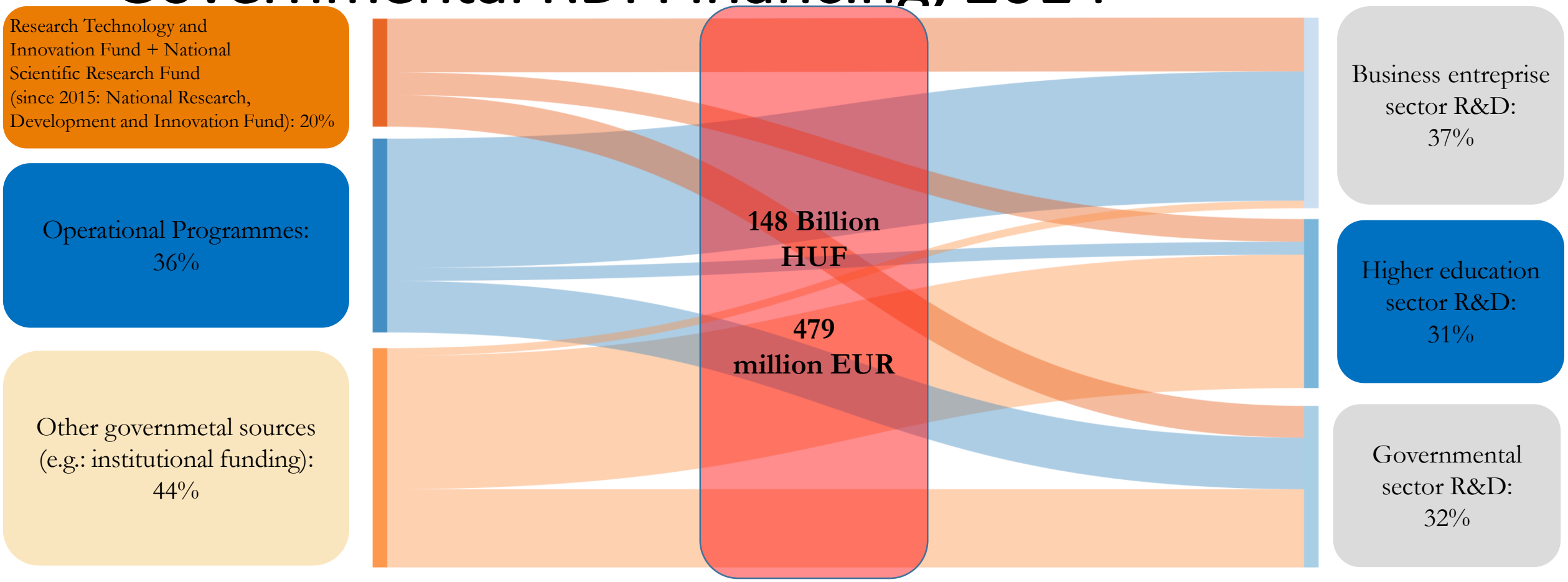


RDI Funding in Hungary (2014)



Total: 441 billion HUF (1.43 billion EUR), 1.38% of GDP

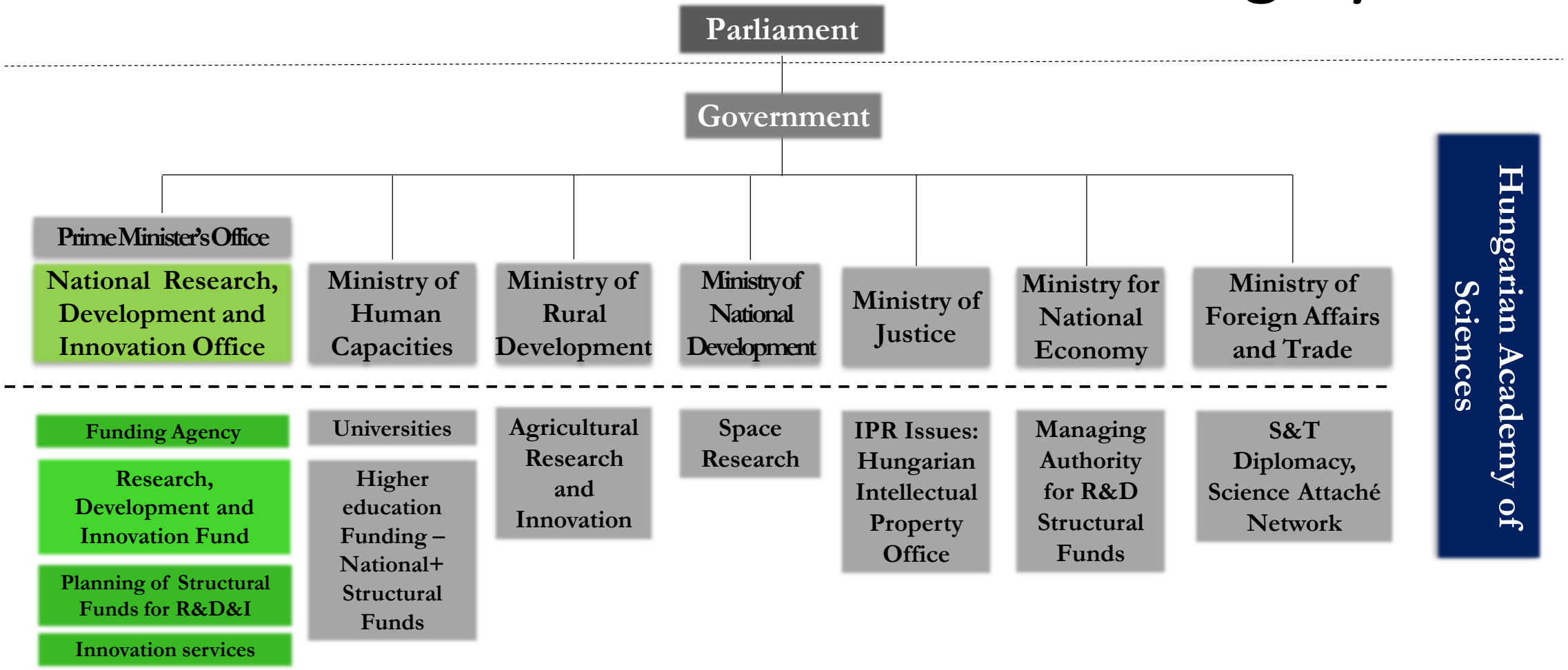
Governmental RDI Financing, 2014



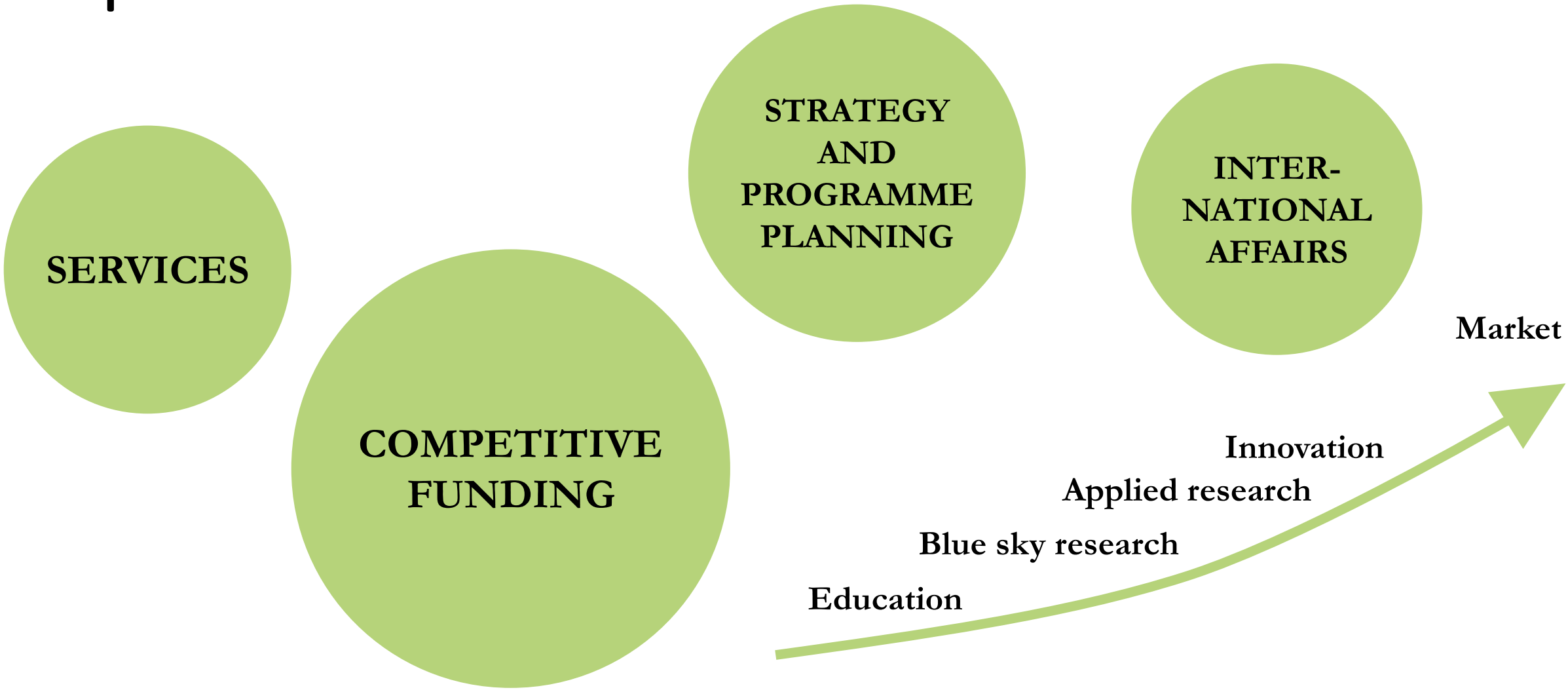
Total: 148 billion HUF (479 million EUR)

Source: HCSO, 2015

Governmental Structure of RDI in Hungary



Who are we? The role of the NRDI Office in the promotion of innovation



The National Research, Development and Innovation Office

- **Mission**
  - To develop RDI policy and ensure that Hungary adequately invest in RDI by funding excellent research and supporting innovation to increase competitiveness.

- **Mandate**
  - To prepare the RDI strategy of the Hungarian Government, to handle the National Research, Development and Innovation Fund, and represents the Hungarian Government and a Hungarian RDI community in international organizations.

The National Research, Development and Innovation Office

- **Vision**
- To be a world-class KFI funding agency, create an internationally attractable KFI environment in Hungary, and a stronger link of KFI to the economy and society for increase growth and prosperity.

- **Values**
  - Excellence
    Transparency
    Integrity
    Trust

Main principles

1. The **long-term international competitiveness** of the Hungarian economy depends on its position in the global value chain. **The final aim is the participation with high-value added activities in the international division of labour.**
2. In order to take into practice this aim, we need **internationally competitive, high-value added RDI activities and programmes** catalysed predominantly by the NKFIH**.**
3. The high-value added, globally competitive KFI activities should be **based on**

   a) world-class, excellent scientific background

   b) talented researchers and other professionals

   c) competitive infrastructures

   d) calculable and transparent financing scheme

International Advisory Board

Prof. Sierd Cloetingh	Prof. Anne Glover	Prof. Bengt Nordén	Prof. Sir George Radda	Prof. G. Julius Vancso
				

The framework conditions of NKFI Fund's financing scheme

- **Problem-oriented and not source-oriented** competitive call for proposals system
- Existing, internationally competitive research background related to the submitted applications
- **Globally competitive, trustworthy partner company**, which can guarantee the usefulness and the competitiveness of the given development projects and **the exploitation of the future KFI results as well.**
- Transparent, calculable operational activity and effective organisational structure
- Competent negotiation partners for the financing organisation

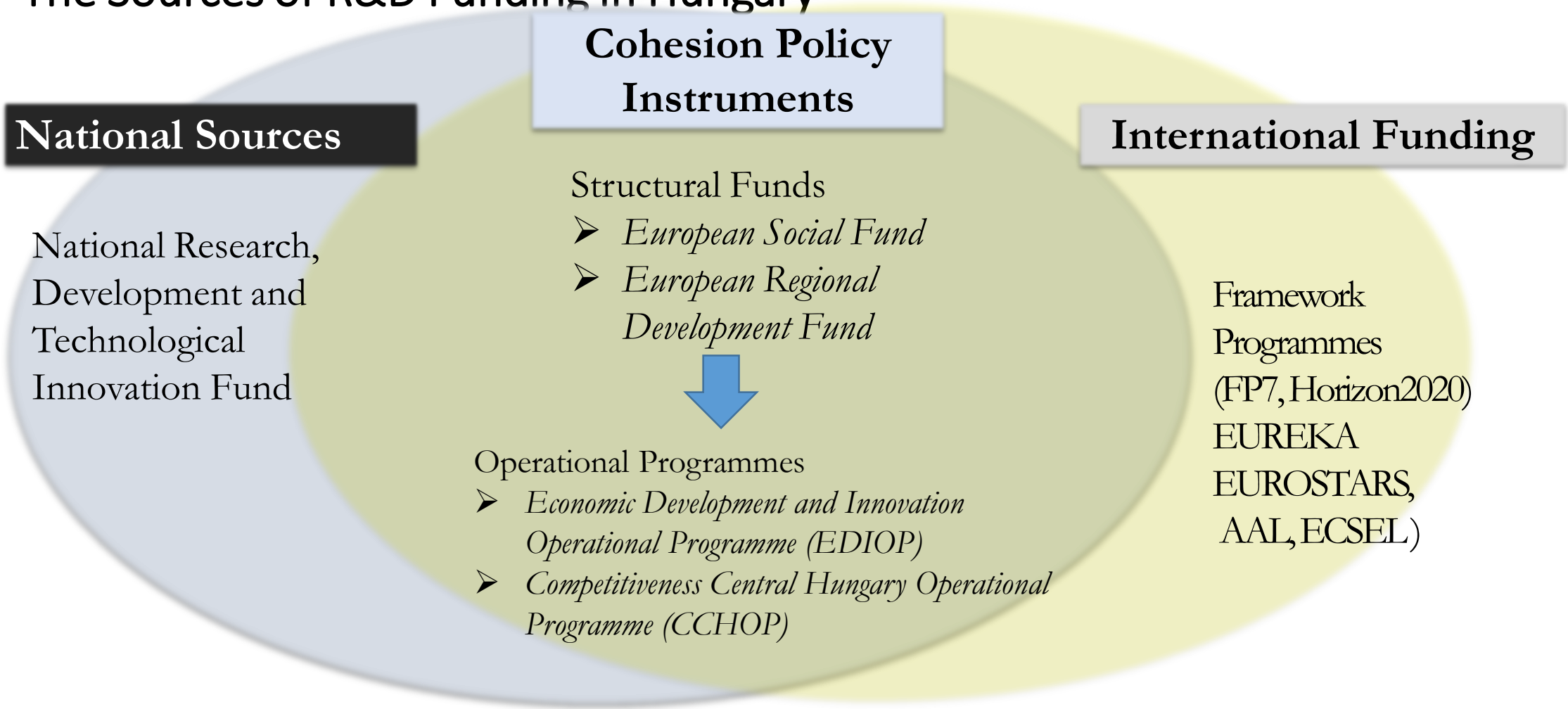
The NRDI Office as a national funding body

- Is in charge of managing the RDI Funds
- Takes part in the planning of calls with RDI focus from Structural Funds
- Supports the Managing Authority by facilitating the coordination and communication between institutional and business RDI actors and various governmental bodies
- Provides expert evaluation services for RDI project applications submitted to the Managing Authority under the EDIOP calls
- Gives policy advice on financial planning and scheduling of calls launched under EDIOP

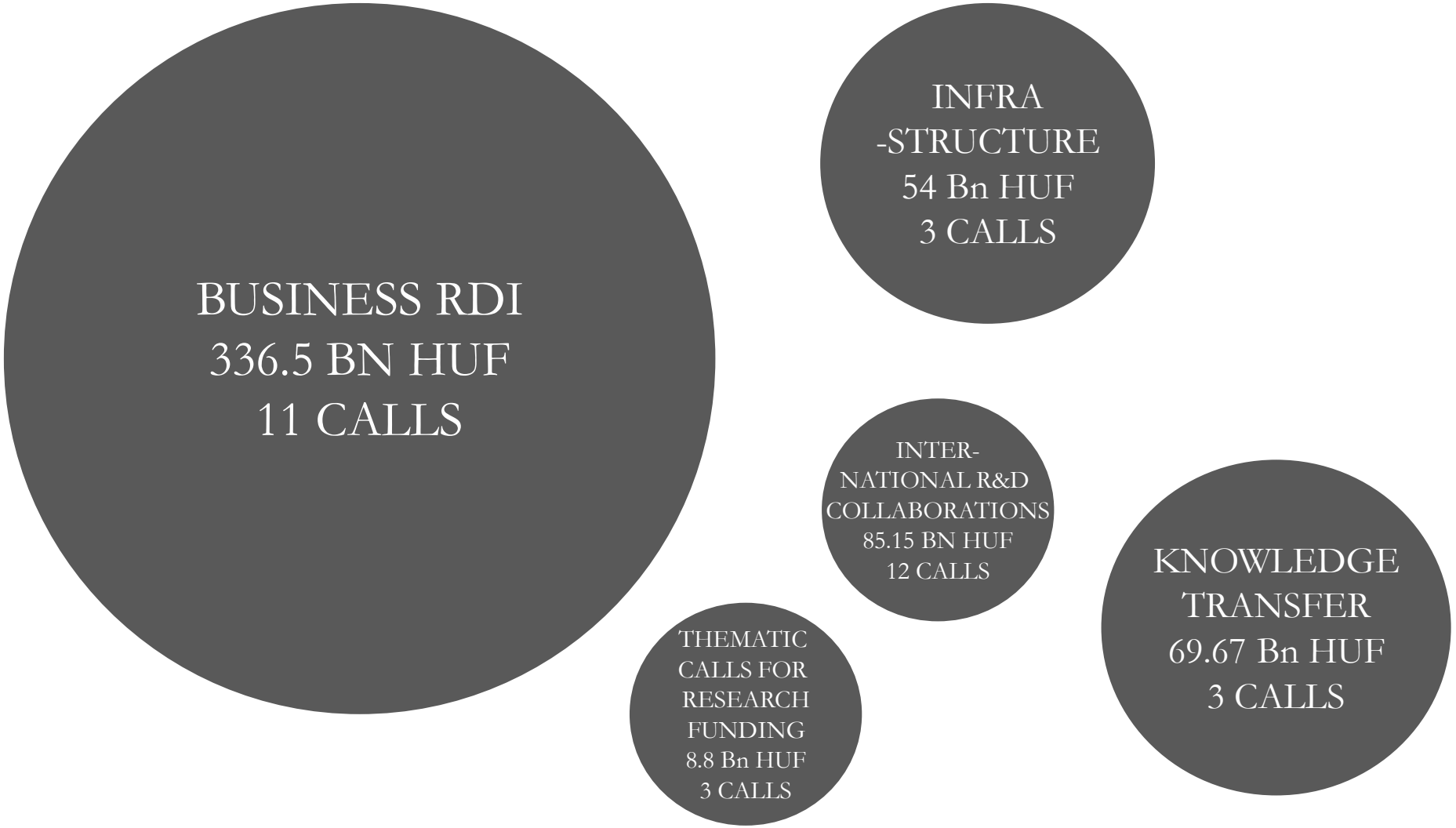
Recent major funding measures of the NRDI Office

- R&D competitiveness and excellence cooperations (50 Bn HUF)
- Excellence of Strategic R&D centres (40 Bn HUF)
- Strengthening research infrastructures (20 Bn HUF)

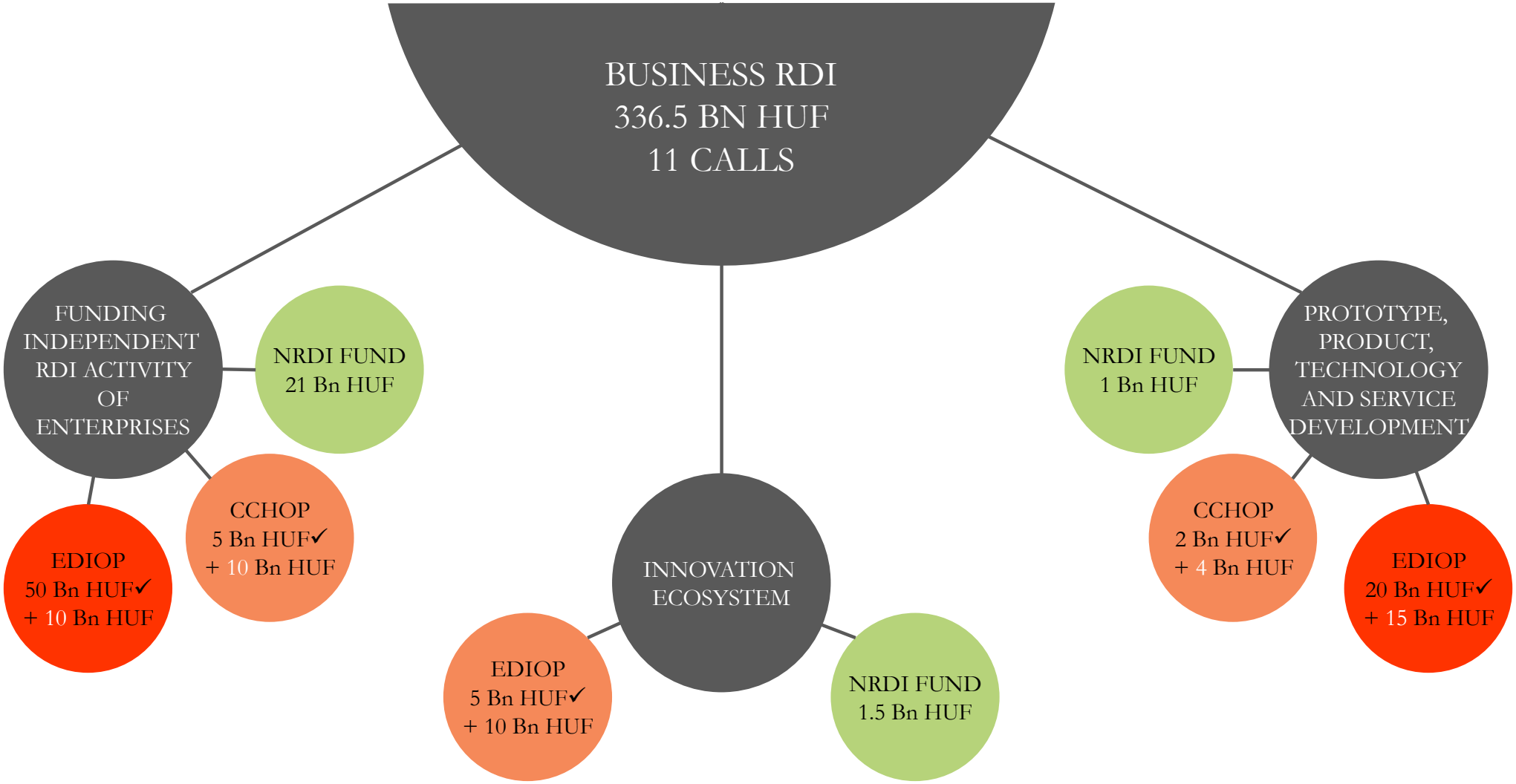
The Sources of R&D Funding in Hungary



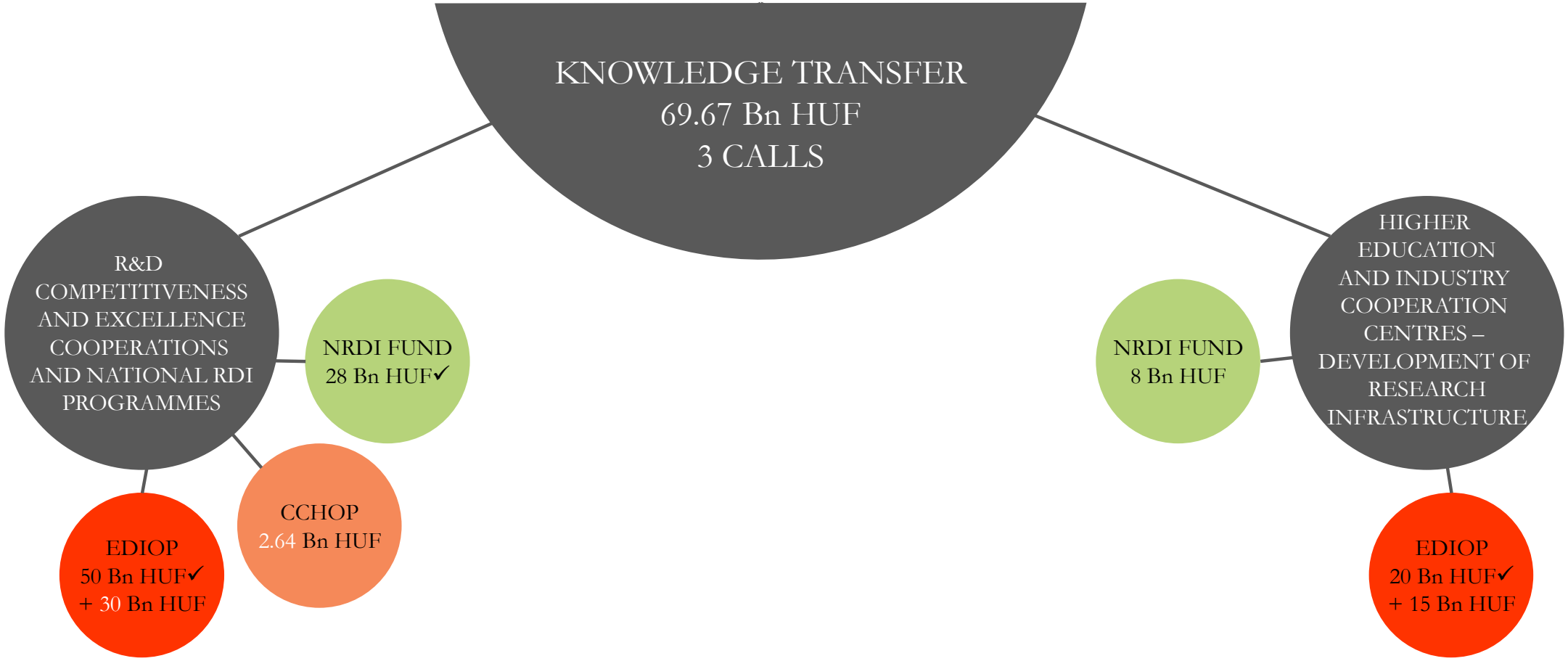
Funding measures in 2015 and 2016



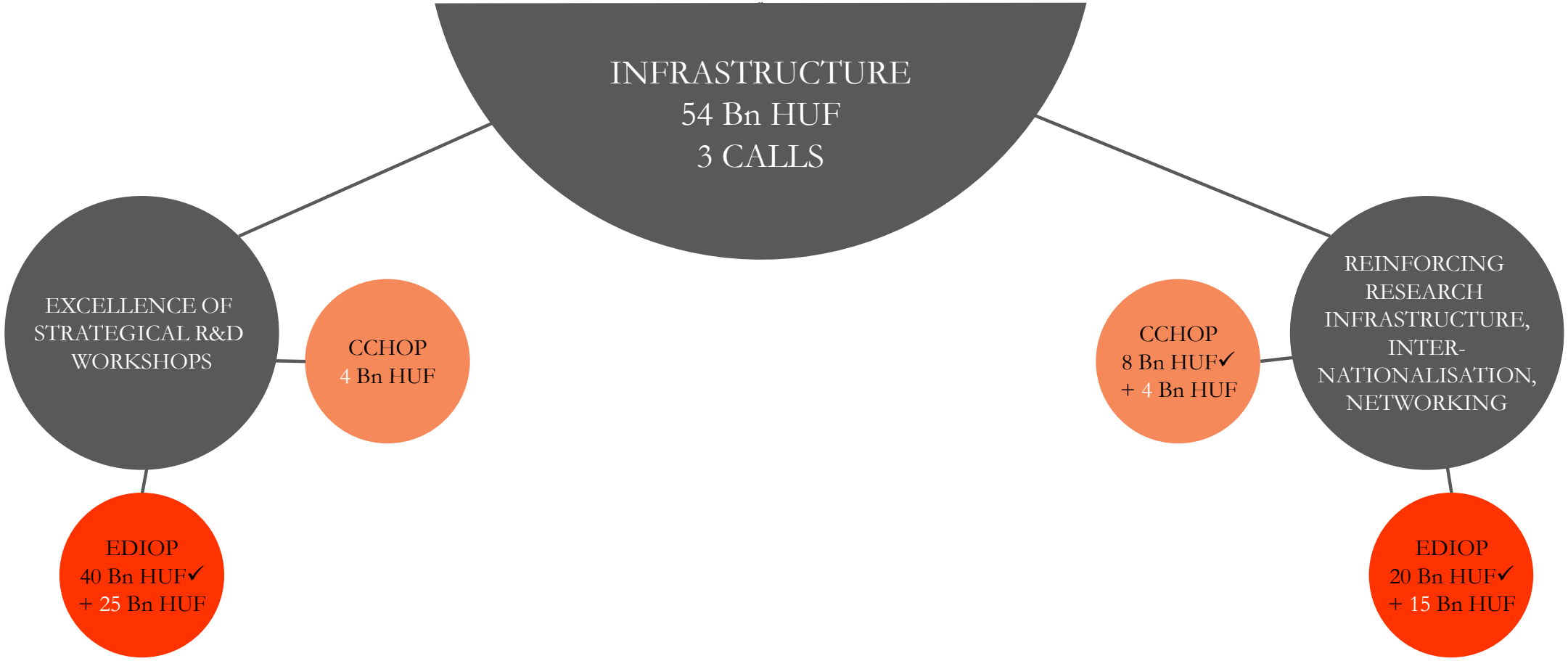
Funding measures in 2015 and 2016



Funding measures in 2015 and 2016



Funding measures in 2015 and 2016



Funding measures in 2015 and 2016

Funding measures in 2015 and 2016

Past and future opportunities for R&D cooperation with Japan

- Multilateral relations
  - JST-V4 Call (past – future?)
  - FP7 related calls – e.g. ERA-NET CONCERT Japan (past)
    - Europe-Japan Interest Group
  - Horizon 2020
    - Japanese participation is welcomed in most of the Calls for Proposals of Horizon 2020. There are also 23 Call topics that specifically target cooperation with Japan in Work Programme 2016-17. More information : http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020_localsupp_japan_en.pdf
- Bilateral relations
  - NN type - Call for proposals for international cooperation in basic research (Active)

Call for proposals for international cooperation in basic research

Purpose

- Supporting basic research leading to excellent results, based on international cooperation.

General conditions

- The proposals have to be submitted by the Hungarian researcher to the NRDI Office and by the foreign researcher to a funding agency in the respective country simultaneously.
- The proposal can be funded only if the Hungarian proposal is supported by NRDI Office and the foreign proposal is supported by the funding agency in the respective country simultaneously.
- An electronic copy of the Declaration on International Cooperation completed and signed by the principal investigator of the foreign matching proposal is part of the NN proposal.

Relevance to Japan

- Hungarian researchers can apply with matching proposals from Japan as well.

ご清聴ありがとうございました.

Thank you for your attention!

www.nkfih.gov.hu/english

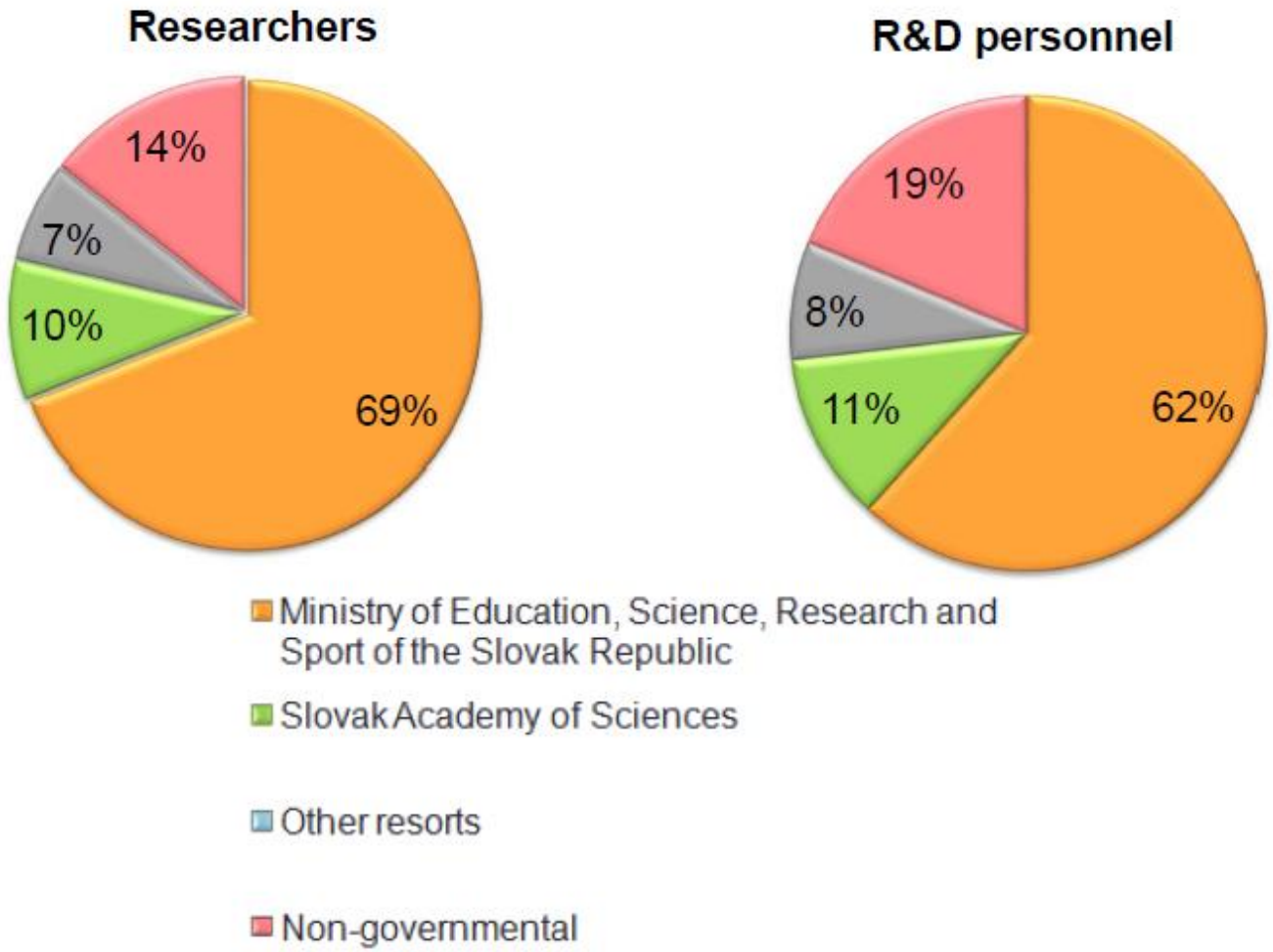
Financial support for International Science &Technology cooperation projects available in Slovakia

J. Lapin

Member of the Presidium of the Slovak Academy of Sciences,
Stefanikova 49, 814 38 Bratislava, Slovak Republic

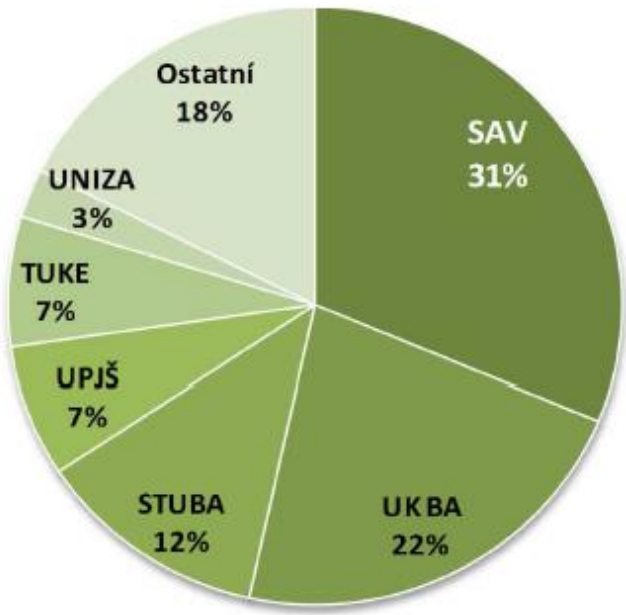
The Joint Visegrad 4 – Japan Seminar on Technology Transfer – Nanomaterials for Industrial Use, 16.6.2016, Tokyo, Japan

R&D in Slovakia

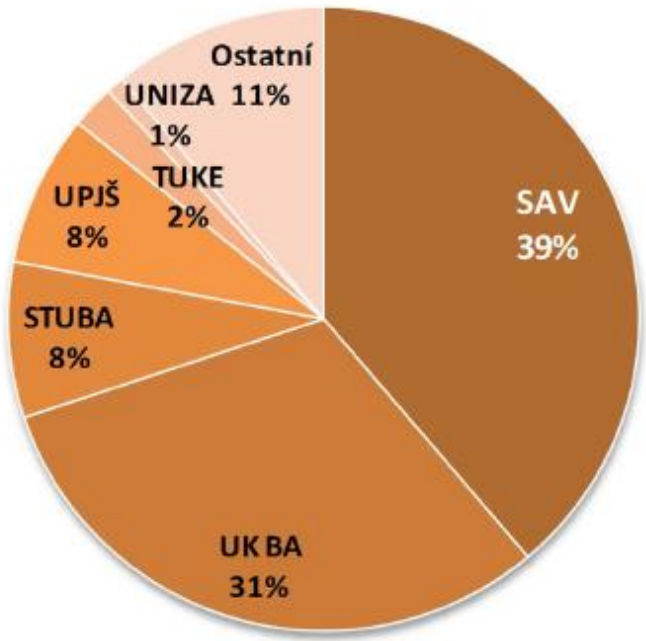


R&D in Slovakia

Publications



Citations



Slovak Academy of Sciences

Slovak Academy of Sciences
Rules of funding

- **Competitive calls for all proposals -** projects selected on the basis of peer review
- **Applicants** – only research organisations of the SAS and researchers hosted or employed by SAS
- **Key criteria for project selection** – excellence of the proposed research, implementation, quality/capacity of the applicants
- **Funding** – usually cofunding of the research organisations is required – mainly personal costs

Slovak Academy of Sciences
Funding Programmes

- **Stefan Schwarz Fellowships for post docs**

since 2004 awarded more than 150 fellowships

- **SAS Scholarship Program**

since 2013 attracting researchers from abroad

- **FP7-Marie Curie – COFUND**

Programme SASPRO - Mobility Programme of the Slovak Academy of Sciences

Slovak Academy of Sciences
Funding Programmes

- Research grant agency – common grant agency funded by the Slovak Academy of Sciences and Ministry of Education, Science, Research and Sport of the Slovak Republic

- SAS International collaboration bilateral and multilateral projects

- ERA net programs, SAS is member of consortia

- FP7-Marie Curie – COFUND
Programme SASPRO - Mobility Programme of the Slovak Academy of Sciences

Slovak Academy of Sciences
Funding Programmes

- SAS – MOST Taiwan common projects
-
- SAS – Tubitak Turkey common projects
- Common projects with European Space Agency
- COSTS projects
- Financial support for HORIZONT 2020 projects

International Scientific Cooperation SAS - Japan

International Scientific Cooperation is one of the strategic and basic pillars of the scientific policy of the Slovak Academy of Sciences (SAS). The international cooperation is divided into bilateral and multilateral scientific cooperation. Both the cooperation between Japan and Slovak researchers and research institutions is playing a very important role

BILATERAL SCIENTIFIC COOPERATION

MULTILATERAL SCIENTIFIC COOPERATION

Japan SAS collaboration within the framework of the 7th FP EU
- CONCERT Japan

JOINT RESEACH PROGRAM (JRP) Vysegrad group – JST

International Scientific Cooperation SAS - Japan

JOINT RESEACH PROGRAM (JRP) Vysegrad group – JST

Memorandum of Understanding
JOINT RESEACH PROGRAM (JRP) V4– JST
common calls for projects applications, seminars, exchanges, other activities

Presidium SAS approved:
Participation of research teams of SAS in common calls
Funding: 3 projects (duration 3 years) 40 000EUr/year - (360 000 EUR)
SAS supports:
Model 1+2 (Japan + SR + 1 V4 country)
exceptionally 1+3 (Japan + SR + 2 V4 countries)

Participation of research teams of Slovakia
Model 1+4 (Japan + all V4countries) Slovak participation supported by IVF

International Scientific Cooperation
SAS - Japan

Call 22.1.2015 : material science

materials for **exterme conditions**
electronic and energy harvesting
light construction materials

Overall Call Budget:

JST (Japan): 18 million JPY at maximum per project for 3 years
MEYS (Czech Republic): 500, 000 EURO in total for 3 years
NKFIH (Hungary): 150,000 EURO in total for 3 years, only for basic research
NCBR (Poland): 500,000 EURO in total for 3 years
SAS (Slovakia): 360,000 EURO in total for 3 years

IVF (V4): 100 000 EURO for the V4 countries in total for 3 years

International Scientific Cooperation
SAS - Japan

Agencies to fund each project model of each country

Researchers' Country	Project Model		
	1+2	1+3	1+4
Czech Republic	MEYS	(IVF &) MEYS	IVF & MEYS
Hungary	NKFIH	(IVF &) NKFIH	IVF & NKFIH
Poland	NCBR	(IVF &) NCBR	IVF & NCBR
Slovakia	SAS*	(IVF &) SAS*	IVF
Japan	JST	JST	JST

*SAS fund only SAS researchers.

Please see ANNEX 1 for the eligibility rules of each agency.

Thank you for attention

EU-Japan cooperation opportunities on Nanotechnologies

Joint Visegrad 4 – Japan Seminar on Technology Transfer: Nanomaterials for Industrial Use
Tokyo – 16 June 2016

stijn.lambrecht@eu-japan.gr.jp

Stijn Lambrecht
JEUPISTE Project Manager
NCP for ICT in Japan
EU-Japan Centre for Industrial Cooperation

The JEUPISTE Project

Name	Japan-EU Partnership in Innovation, Science and TEchnology
Period	2013/9～2016/8
URL	http://www.jeupiste.eu

10 partners:
- IIST (JP)
- DLR (DE)
- APRE (IT)
- TUBITAK (TR)
- FORTH (GR)
- **RCISD (HU)**
- AGAUR (ES)
- INSME (IT)
- ZSI (AT)
- KOBE U (JP)

Aims of the JEUPISTE Project

1. Support to policy dialogues
2. Facilitate Bilateral Dissemination
3. Organize Networking and Twinning
4. Offer Helpdesk and Training of Experts
5. Develop a Communication platform for Horizon 2020 in Japan

JEUPISTE and Nanotechnologies

- **Advanced Materials including Nanotechnologies is one of the focus areas of JEUPISTE**, next to ICT; biotechnology; innovation in SMEs; health, demographic change and well-being; secure, clean and efficient energy; inclusive, innovative and reflective societies
- **JEUPISTE Thematic Activities on Nanotechnologies:** dissemination of Horizon 2020 and partnership building for new EU-Japan projects.
- Past activities:
  - Dissemination of Horizon 2020 nano-related work programme: **Seminar on Nanotechnologies and material sciences (**Kobe, 29 May 2014)
  - Facilitating new partnerships: **Power Electronics Symposium (**Tokyo, 15-16 December 2015)
  - Booth at **Nano tech 2016** for promotion of Horizon 2020 (Tokyo, 27-29 January 2016)

大阪大学
OSAKA UNIVERSITY

JEUPISTE

JEUPISTE/Osaka University WBG-i symposium on Power Electronics
15-16 December 2015 (EU Delegation to Japan, Tokyo)

- At the occasion of nanotexnology 2016 in Greece, the JEUPISTE project organises a workshop **on 5 July 2016, 15:00-18:30, Porto Palace Hotel, Thessaloniki, Greece**
- **JEUPISTE Workshop for EU-Japan Academic Partnership Building**
  - Focus on nanomaterials and bionanoscience
  - Enable networking within research communities
  - Presentation session for projects that have potential for EU-Japan cooperation
  - Presenters selected on the basis of an open call
- Target: Researchers and R&D managers from public/private organizations in the field of Nanomaterials and Bionanoscience
- Open for participation: http://jeupiste.eu/AW-Greece-EN

NCP for Horizon 2020 in Japan

EU-Japan Centre
for Industrial Cooperation
日欧産業協力センター

- EU-Japan Centre for Industrial Cooperation is the official **National Contact Point for Horizon 2020 in Japan**.
- NCP is a system developed by the European Commission based in all European countries and most third countries, to provide local support.
- Goal: provide guidance, practical information and assistance on all aspects of participation in Horizon 2020
- Collaboration with Enterprise Europe Network (EEN), JEUPISTE project, NCP thematic networks
- Japanese portal site for Horizon 2020 : **http://www.ncp-japan.jp**

Services by JEUPISTE/NCP

- A **help desk** for any inquiry related to Horizon 2020
- Actively helping Japanese organizations to participate in Horizon 2020 by providing them **with tailored information** and **practical information on administrative issues** that might arise
- Providing a **website in Japanese** with easily accessible information on Horizon 2020 and how to participate
- Providing **Japanese translations of key documents** in Horizon 2020 (such as the Grant Agreement) for easier access to Japanese organisations
- Providing **trainings** for research administrators and managers to deal with EU research projects
- Organising **events for networking** in specific areas
- Partner search support

Support to search for cooperation partners / customers in Japan for EU and Japanese SMEs and Clusters

NANOTECHNOLOGIES CLUSTER & SME SUPPORT MISSION TO JAPAN

Organised in Japan for 5 days on the fringes of the “nanotech - International Nanotechnology Exhibition and Conference”: http://www.nanotechexpo.jp/

Mission dates: 11 – 15 February 2017 / Application deadline: 27 October 2016

Clusters and companies operating in the following Nanotech-related sectors are invited to apply:

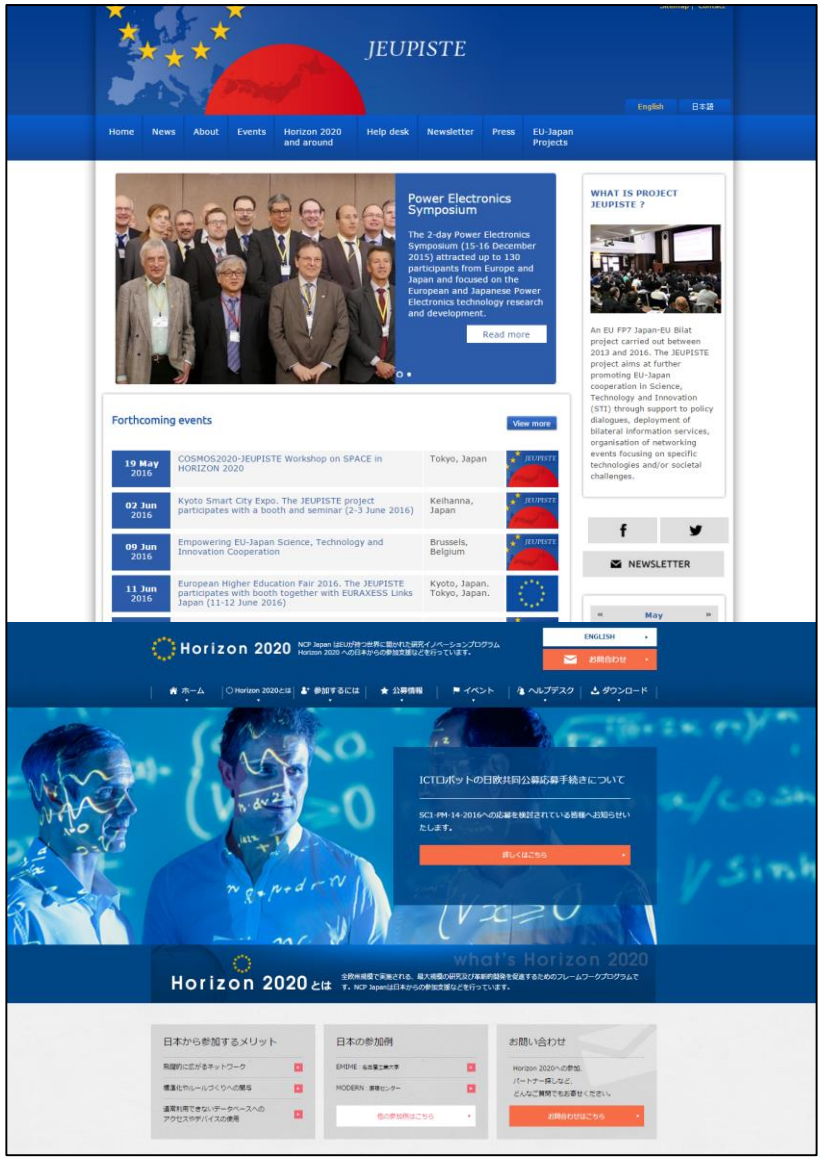
- Nano Materials
- Nano Evaluation & Measurement
- Nano Fabrication Technology

http://www.eu-japan.eu/events/nanote

More information

JEUPISTE Project
http://www.jeupiste.eu
jeupiste@eu-japan.gr.jp

NCP Japan
http://www.ncp-japan.jp
ncp-japan@eu-japan.gr.jp



Institute for Nanomaterials, Advanced Technologies and Innovation (CxI):

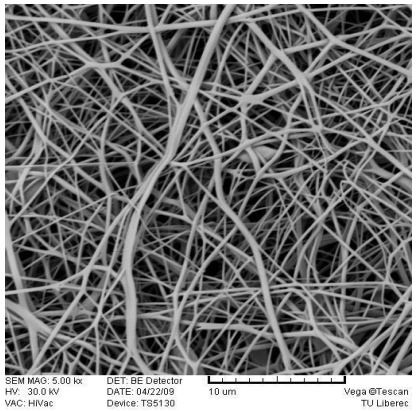
“Nanomaterials and their use in practice“

Adam Blazek
Director of Industry Relations

… where NANOSPIDER™ was born …

Agenda

- Short history of nanoresearch at TUL
- Who we are – foundation of CxI
- Nano-oriented Research
  - The application of nanofiber materials
  - The application of new progressive methods for remediation and water treatment
  - Preparation and analysis of nanostructures
  - Special patented technology for the production of emulsions.



2000: First experiments with electrospinning
2004: world-wide patent → Elmarco
2015: AC electrospinning

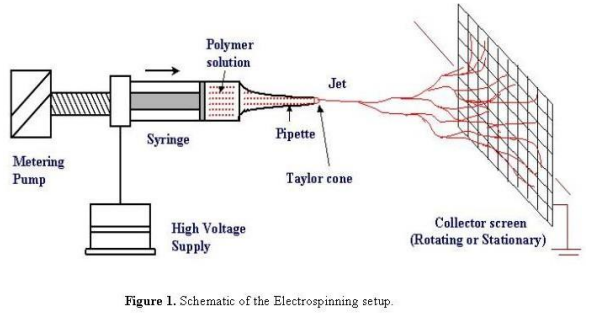
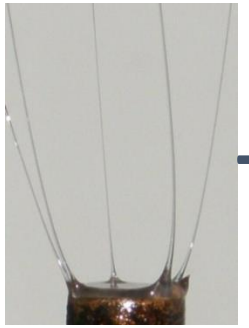
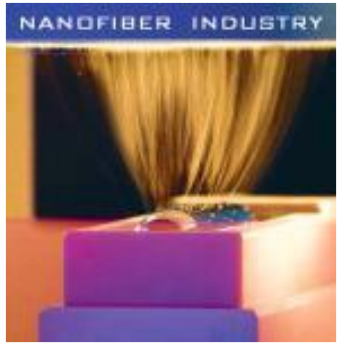


Figure 1. Schematic of the Electrospinning setup.





Genesis and history of CxI

The CxI Center

- Nanofibre production → nanoresearch at TUL
- was established in 2009 and financed from European fund for regional development (ERDF) and a state budget of the Czech Republic through Operational program: Research and Development for innovation (VaVpl) (till 2013)
- focuses on preparation and application of new materials, mainly nanomaterials and advanced industrial designs and technologies
- nowadays in the sustainability phase (till 2018)

Research Programs

Institute for nanomaterials, advanced technologies and innovation has ambitions to become state of the art research center for development and innovation in these areas:

Material research

focusing on research, development, processing and applications of **progressive materials**, especially **nanomaterials**

Competitive engineering

focusing on research, development and utilization of **advanced engineering constructions and technologies**, in particular **mechatronic systems**, **propulsion units** and other components of machines and vehicles and progressive methods for the **processing of new materials**

Laboratories and Departments – see booklet

- Department of Nanostructure Preparation and Analysis
- Department of Physical Measurements
- Department of Nanomaterials in Natural Science
- Department of Nanotechnology and Informatics

20 Laboratories

- Laboratory of Metamaterials

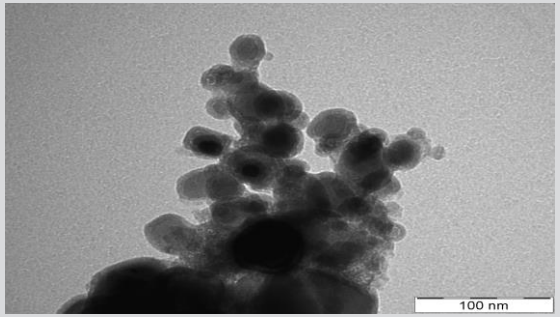
- Department of Machinery Construction
- Department of Vehicles and Engines
- Department of Industrial Technology
- Department of Robotic Systems And Mechatronic Systems

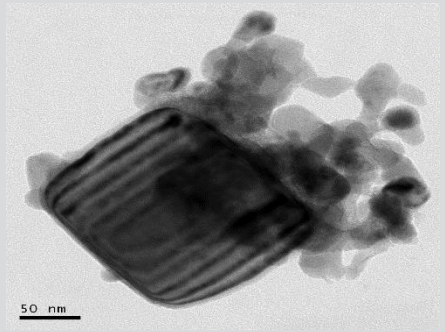
International grants

- 7.Framework projects EU 3
- H2020 projects 3
- Central Europe 1
- Eureka 1
- CZ-USA 1
- CZ-China 1
- TEAMING 1

Over 80 internaional partners (30 in close collaboration)

Mostly in environmental applications of nanomaterials and risks of nanomaterials – international relevance





Types of cooperation

Exclusive relations

Non-exclusive relations

Individual short-term contracts

Long-term collaboration
(framework agreement, collaboration agreement, NDA)
– series of subsequent contracts

Partnership within grant projects

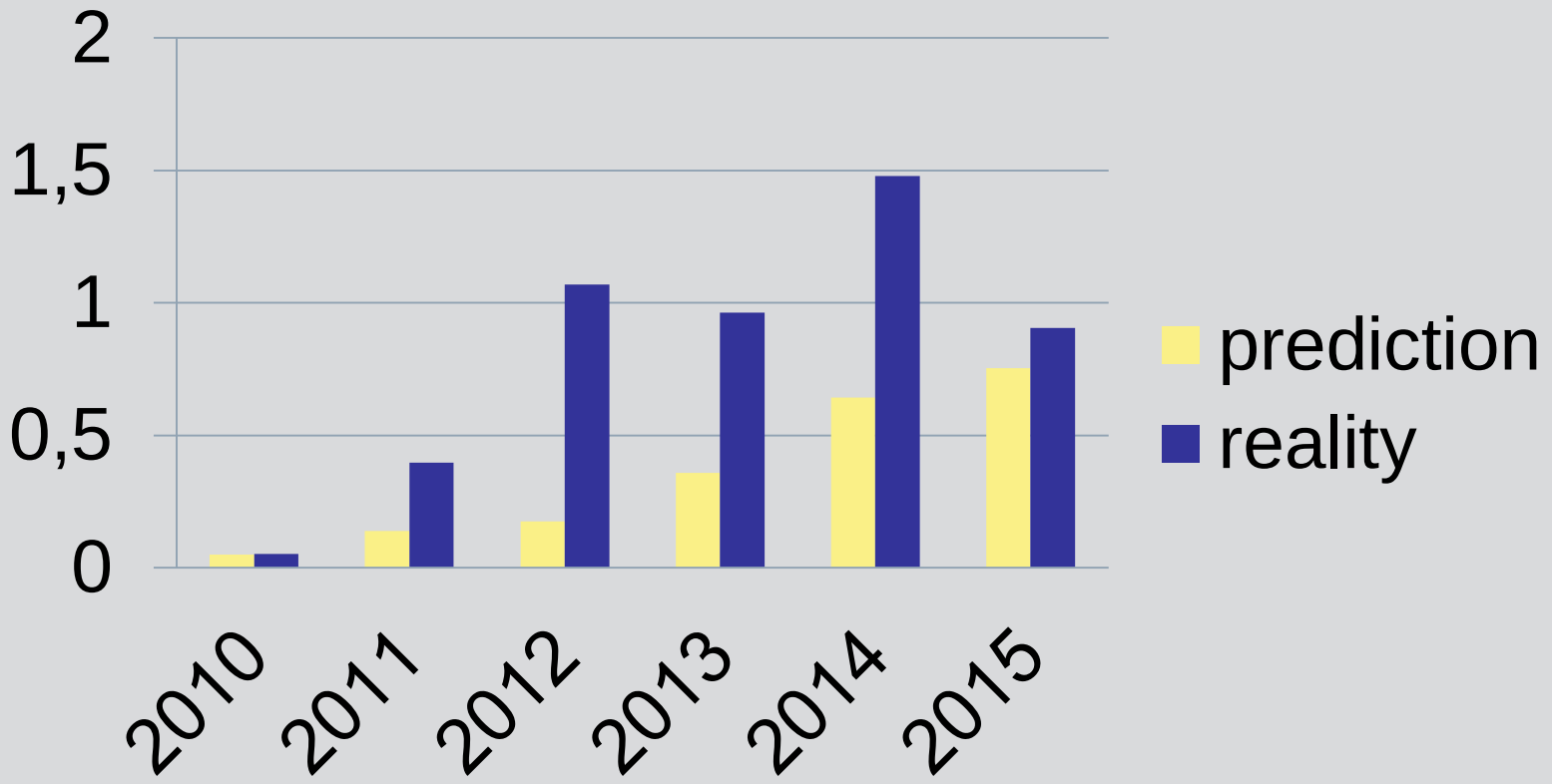
Association
(„consortium“, „active network“)

Applied research and development

Basic / searching research

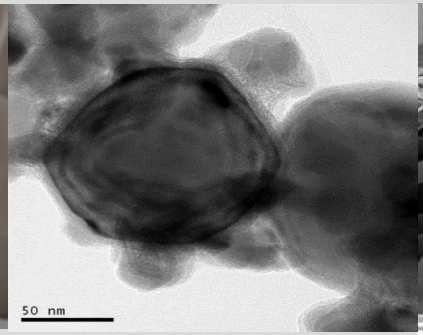
Contractual Research

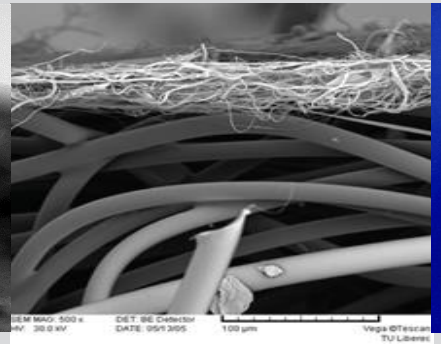
Annual income (in mil. €)

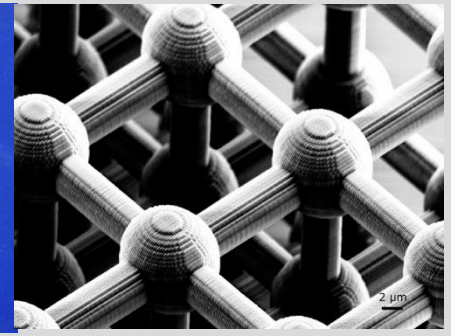


Departments in nano-oriented research

- Preparation and analysis of nanostructures - nanolayers, nanocomposites (e.g. PIKATEC).
- Nanomaterials in natural science – remediation, nano Fe, risk of nanomaterials.
- Nanotechnologies and Informatics - nanofibrous applications
- New Laboratory of metamaterials - multiscaled structure-tuned materials





Nanomaterials in natural science

Biotechnology

Development and verification of the use of nanomaterials in environmental technologies.

- Development and verification of environmental biotechnology aimed at the elimination of xenobiotic and anthropogenic waste from the environment.
- Comprehensive solutions to specific problems for various components of the environment, particularly wastewater, contaminated land, waste air emissions, biogas and eutrophic lakes.
- Use of new material research findings and their application in environmental technologies, support of research and development of new linear and planar nanofibrous formations.

Example - application of nanofibers as a biomass carrier for wastewater treatment or a carrier of other nanoparticles for targeted modification of ultrafiltration membranes. Patented technology is already implemented in several Sewage Treatment Plants.

Nanomaterials in natural science

Chemical Remediation Processes

Development of new methods for remediation of contaminated groundwater, surface water, wastewater and industrial water based on chemical action on selected contaminants.

- Application of new methods for water treatment and remediation, the application of nanomaterials in remediation technologies and study of the potential hazards of nanomaterials.
- Research of zero-valent nanoiron improvement, combined oxidation, reduction and biological remediation methods and materials for transmission of electrical energy and heat in geological structures.

Project Nanomaterials for water remediation

(cooperation of TUL, Aquatest, Institute for Soil Science, Chinese Academy of Science, Jiangsu DDBS Environmental Remediation Co.,Ltd.)

The main objective of the project is to develop and put into practice new materials and processes for water remediation. Two main activities will be implemented.

- Water treatment using nano/micro iron particles (reductive and oxidative mechanisms). Synergic effect of cleaning biological processes using surface modification by biological activator will be implemented.

- Water treatment using membranes and nanomaterial filters with biocidal modification. This applied research and optimization to the specific conditions will lead to a significant cost reduction in remediation methods.

Nanotechnology and Informatics

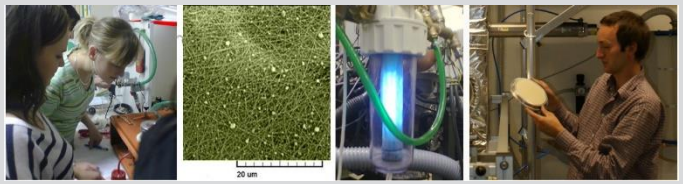
•Nanomaterial Applications

•Acoustics

- ***Construction*** *(panels, foam, wool, fleece, fasteners),* ***Engineering*** *(soundproofing material of fridges, washing machines)*
- ***Automotive*** *(noise and vibration control of cabs and engines),* ***Phonics*** *(soundproofing of halls, rooms, headphones, speakers)*
- ***Functional decoration*** *(paintings, carpets, wall decorations)*
-

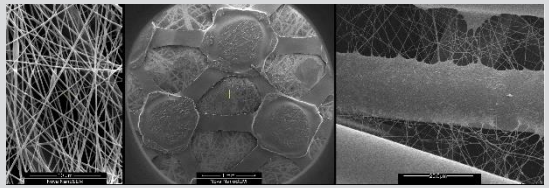
•Filtration

- ***Filtration of hot combustion products*** *- elimination of solid polluting substances and*
- ***Filtration of atmospheric air -*** *dust filtration and elimination of hazardous gasses and microorganisms*
- ***Filtration of liquids*** *- elimination of specific substances from drinking or industrial water*



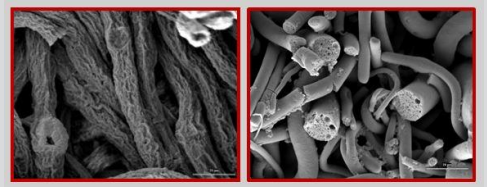
•Membranes

- *Sterile Filtration Membranes*
- *Breathable & Hydrophobic Membranes*
- *Nanofibre Adhesion*
- - used in pharmaceutical, food and special chemistry industry



•Biodegradable Materials

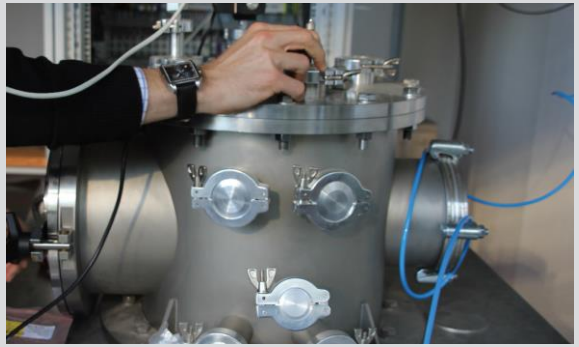
- *Filtration Materials*
- *Hygiene Materials*
- *Tissue Engineering Materials*



Preparation and analysis of nanostructures

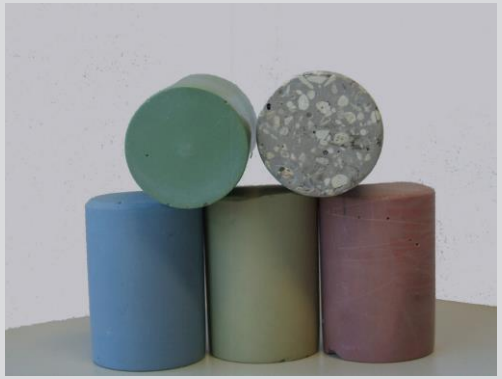
•Plasmatic treatment

- **Research** of the surface modification of metallic and nonmetallic materials using thin layers produced by plasmatic methods.
- **The main objective** of plasma treatment is to improve the utility properties of the modified components - increase their durability, hardness and improve wear resistance and low friction coefficient.
- **Applications** - automotive industry, engineering, energy, and medicine etc. Hard and wear-resistant thin layers can also be used as protective coatings on machine tools.
    - Partners – Skoda Auto a.s.



•Geopolymer nanostructures

- **Preparation** of special geopolymer mixtures, analysis of their structures and their properties.
- **The main objectives** and activities are ***preparation and verification of geopolymers*** for specific use in conditions of very high temperatures with high resilience, ***construction of composites*** with nanoparticular, short-fibrous and long-fibrous reinforcement from inorganic and organic materials, ***verification of application options*** of geopolymers for restoration, repair and other purposes.



Preparation and analysis of nanostructures

•Nanocomposite materials

- Preparation of nanoparticles using wet and dry grinding technology. The aim is to prepare particles with a low degree of agglomeration as well as suitable distribution for further processing with nanocoating technology or classical coating technology.

- The main objectives and activities
  - Research and development of nanocomposite materials.
  - Research of technologies for the preparation of micro and nanoparticles and their applications in thin layers on substrate surfaces.
  - Comprehensive solutions to the issues of distribution of particles in coating material in the form of pastes, foams or solutions.

THE IMPREGNATION EMULSION CONTAINING NANOPARTICLES (TiO_2 , SiO_2 AND ZrO_2)

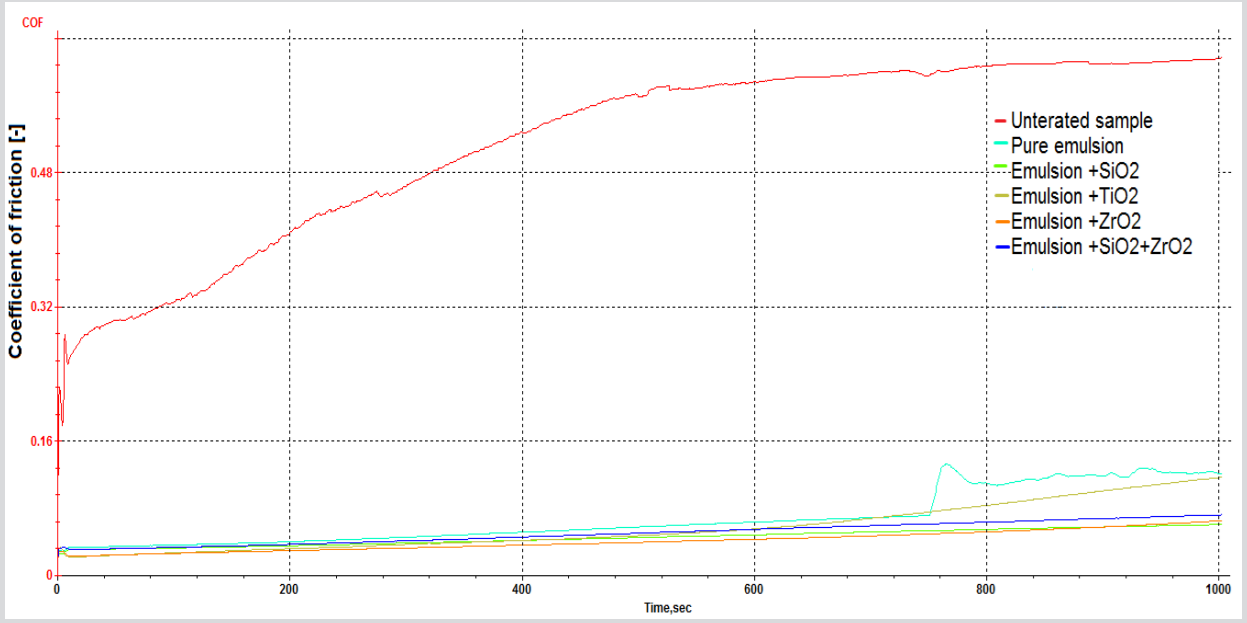
•An aqueous emulsion of methyl-silicon resin was mixed together with Adeps Lanae (lanolin) or 1 - hexadecanol in a defined ratio. In to thus prepared emulsions were added the nanoparticles of metal oxides (TiO_2, SiO_2 and ZrO_2) during the mixing.

- Patented technology
- Transparent
- Chemically and heat resistant – up to 700 °C
- Can be used for different types of material

THE IMPREGNATION EMULSION CONTAINING NANOPARTICLES

- **Polycarbonate and glass**

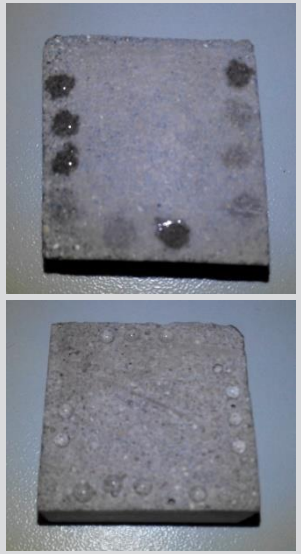
- To increase the hydrophobicity and abrasion resistance while creating an antistatic layer that would prevent the accumulation of dirt on the surface of the polymer.



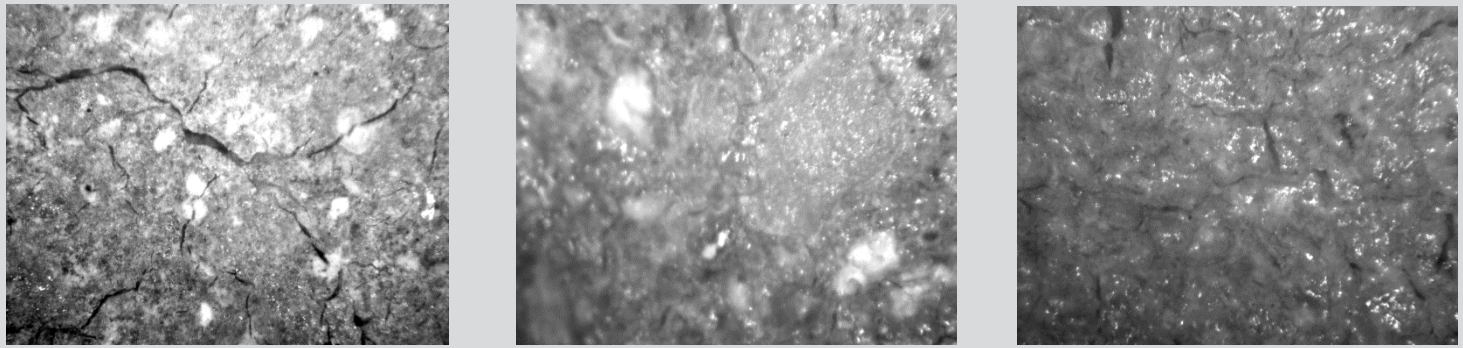
THE IMPREGNATION EMULSION CONTAINING NANOPARTICLES

•Geopolymer

•Tested substrate was BAUCIS L 160. It is geopolymeric binder based on fire clays which is light gray in color. The alkalination was done with the use of sodium solution.



The hydrophobicity effect of impregnation emulsion
top) untreated sample
bottom) treated sample



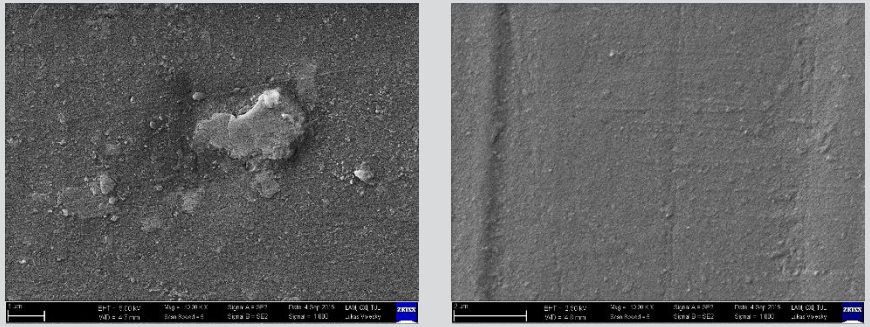
700°C left) untreated sample, middle) pure emulsion, right) emulsion with nanoparticles

THE IMPREGNATION EMULSION CONTAINING NANOPARTICLES

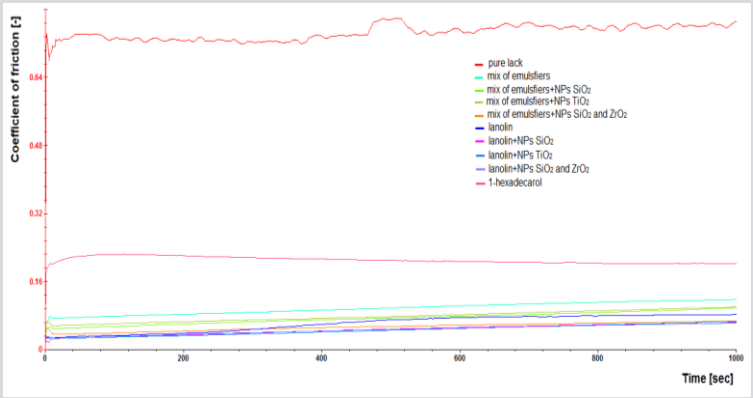
PIKATEC

- Autolack

- Cooperation with company Pikatec which led to the joint workplace.
- Unique system of car protection does prolonged exposure - about 15 000-20 000 km.
- Nanoparticles form invisible transparent layer on the surface of the car, a sort of hard protective shield which penetrates into the pores of the glass, smoothing its surface and thus reduces the aerodynamic drag.

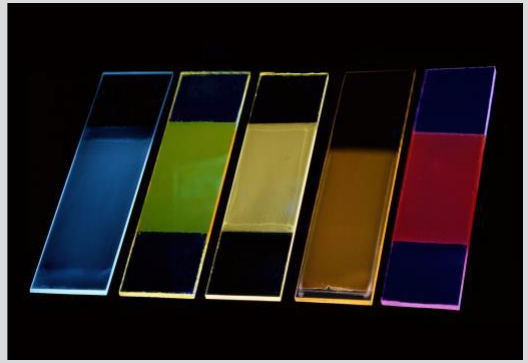


The difference in the structure of the surface left) before and right) after applying the impregnation (magnification 10 000x)



Why CxI is ready for nano-oriented industry

- Centre is established and in full operation (all criteria satisfied)
- Relevant research team
- Balanced budget – sustainable state
- Well-defined research areas, international relevance
- International cooperation established (11 projects)
- Intensive cooperation with industry (190 contracts, over 1 mil €)
- New multifunctional nanoparticles



TECHNICKÁ UNIVERZITA V LIBERCI
Ústav pro nanomateriály, pokročilé technologie a inovace

Studentská 1402/2 | 461 17 Liberec 1 | tel.: +420 485 353 006 | e-mail: cxi@tul.cz

cxi.tul.cz

Research on the Top

Shear thickening fluids for energy absorbing systems

Łukasz Wierzbicki and Marcin Leonowicz

Warsaw University of Technology
Faculty of Materials Science and Engineering

The Joint JST - Visegrad 4 Seminar on Technology Transfer, 2016

Rheology

rheo → logos

(flow) (word, science)

Rheology is the study of the flow of matter

The term **rheology** was coined by Eugene C. Bingham, a professor at Lafayette College, in 1920, from a suggestion by a colleague, Markus Reiner. The term was inspired by the aphorism of Simplicius (often misattributed to Heraclitus), **panta rei** - "everything flows"

Fluids classification

η - viscosity

τ - shear stress

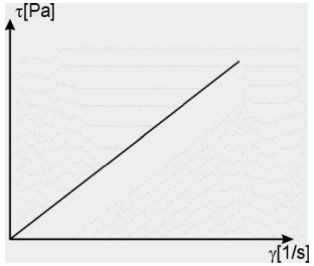
$\dot{\gamma}$ - shear rate

t - time

fluids

Newtonian

η = const.



$\eta \neq$ const.

Non-Newtonian

$\tau \propto (\dot{\gamma})$

$\tau \propto (\dot{\gamma}, t)$

Dynamic viscosity

$\eta = \tau / \dot{\gamma}$ [Pa•s]

rheo-stable

rheo-unstable

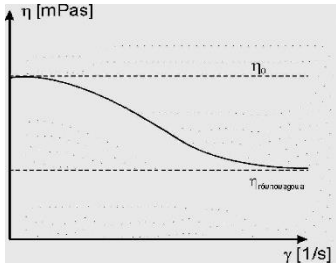
pseudoplastic

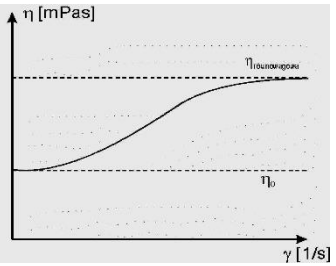
dilatant

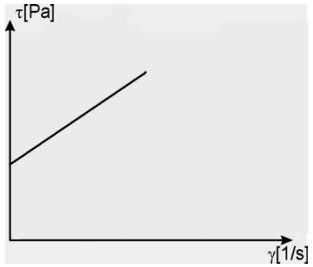
Bingham plastic

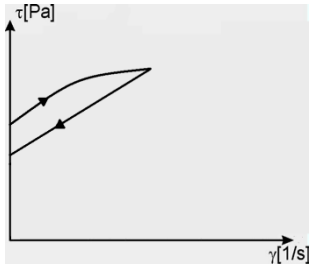
thixotropic

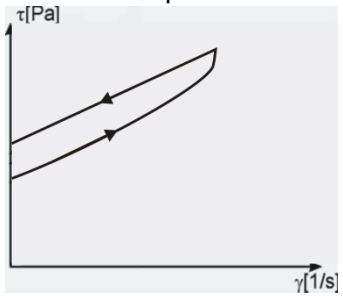
rheopectic





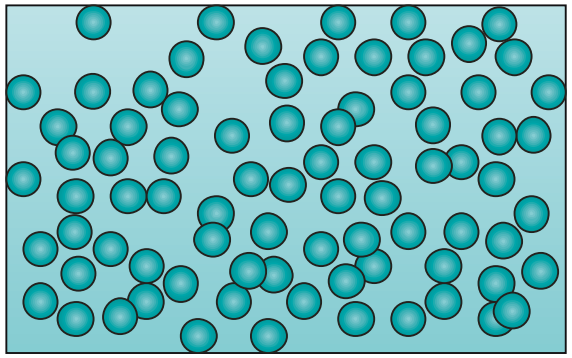




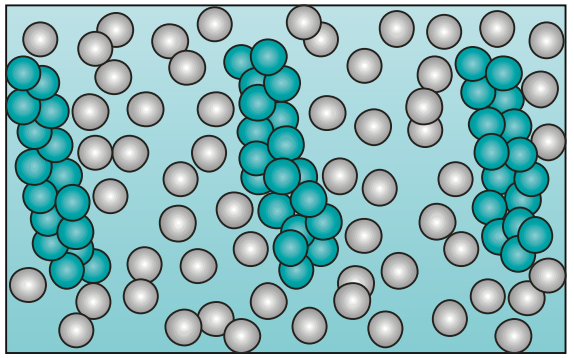


Shear thickening fluid – dilatant - mechanism

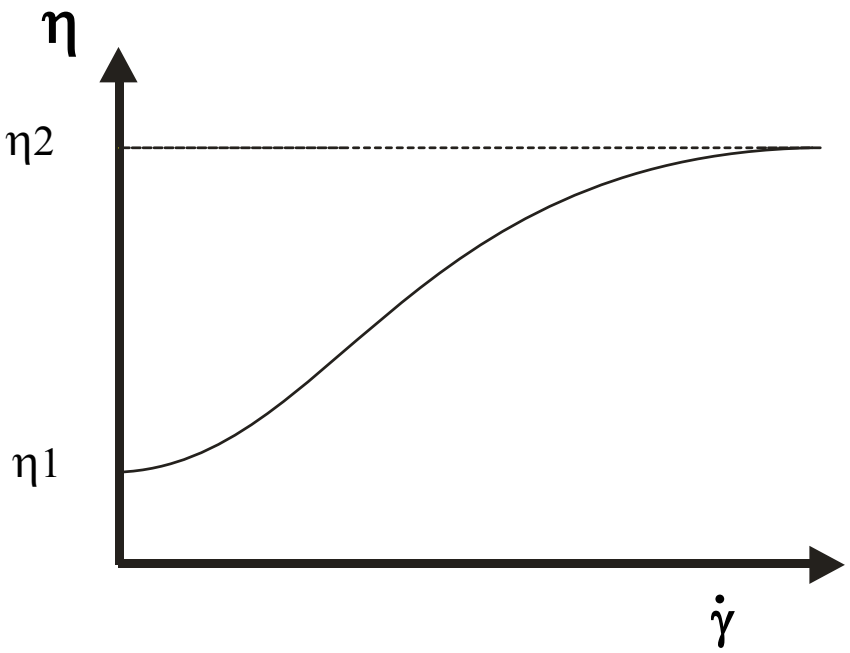
Clustering theory – Brady i Bossis



Stable colloidal system



Structure created by the shear

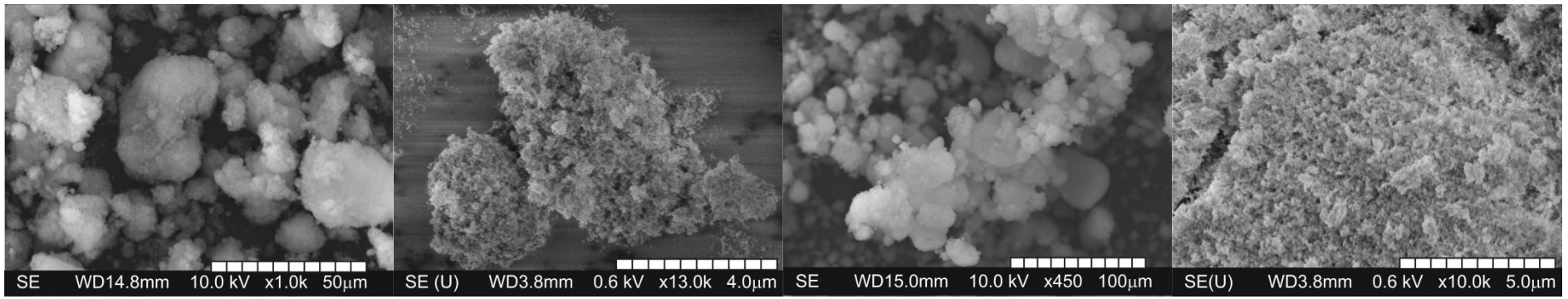


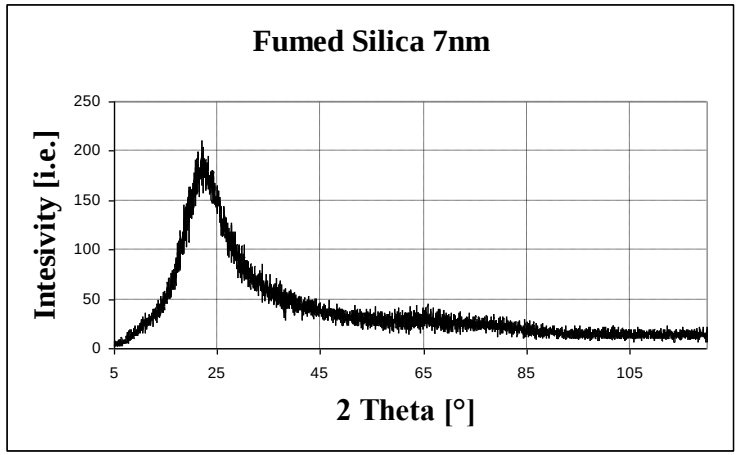
Smart materials – have the ability of predictable and recurrent response to the external stimuli. They act as a sensor, processor and actuator.

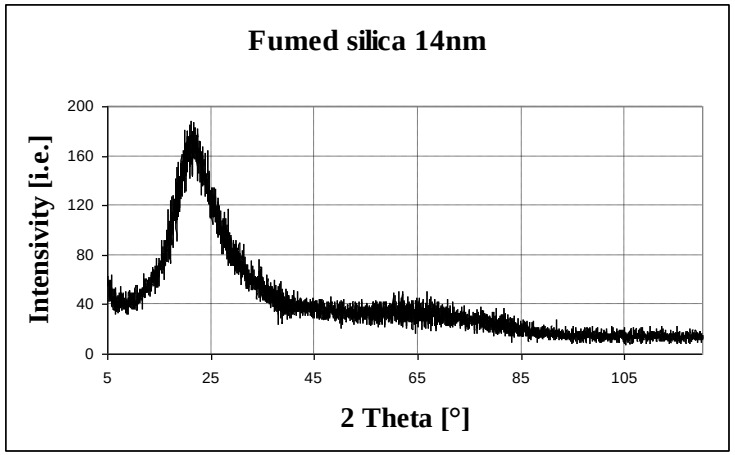
Fumed silica (FS7 i FS14)

Fumed silica – pyrogenic silica, produced in a flame

FS7 FS14

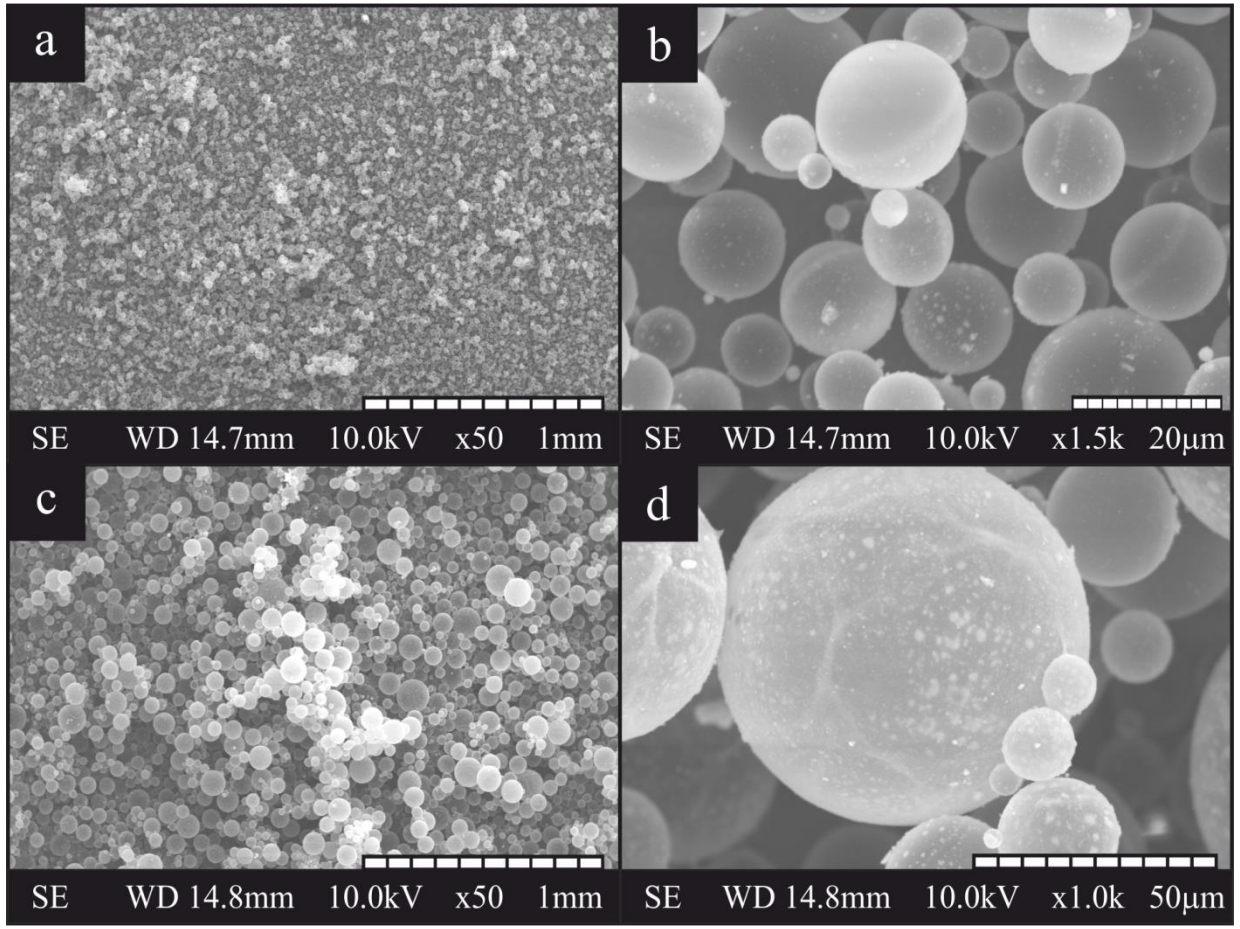




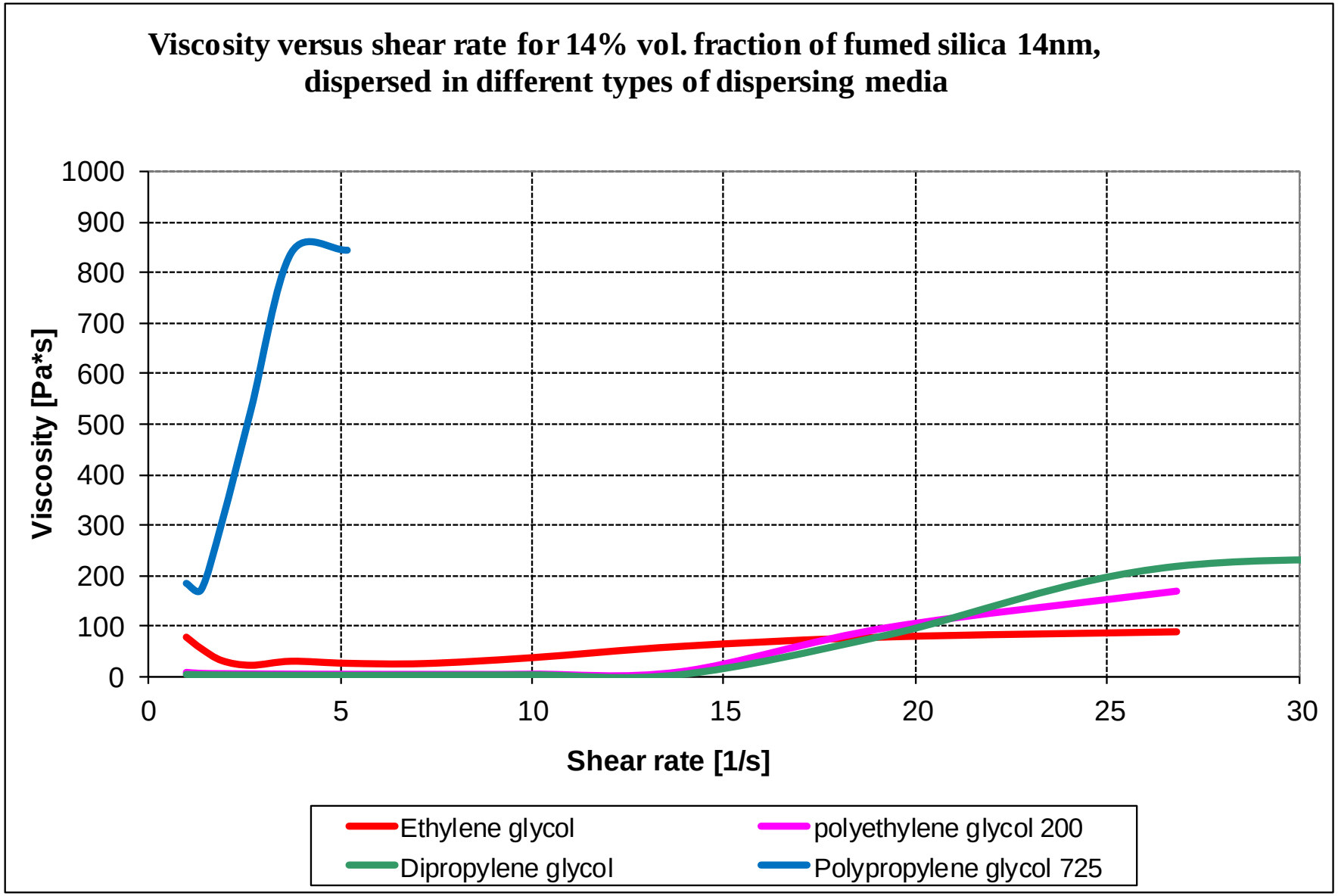


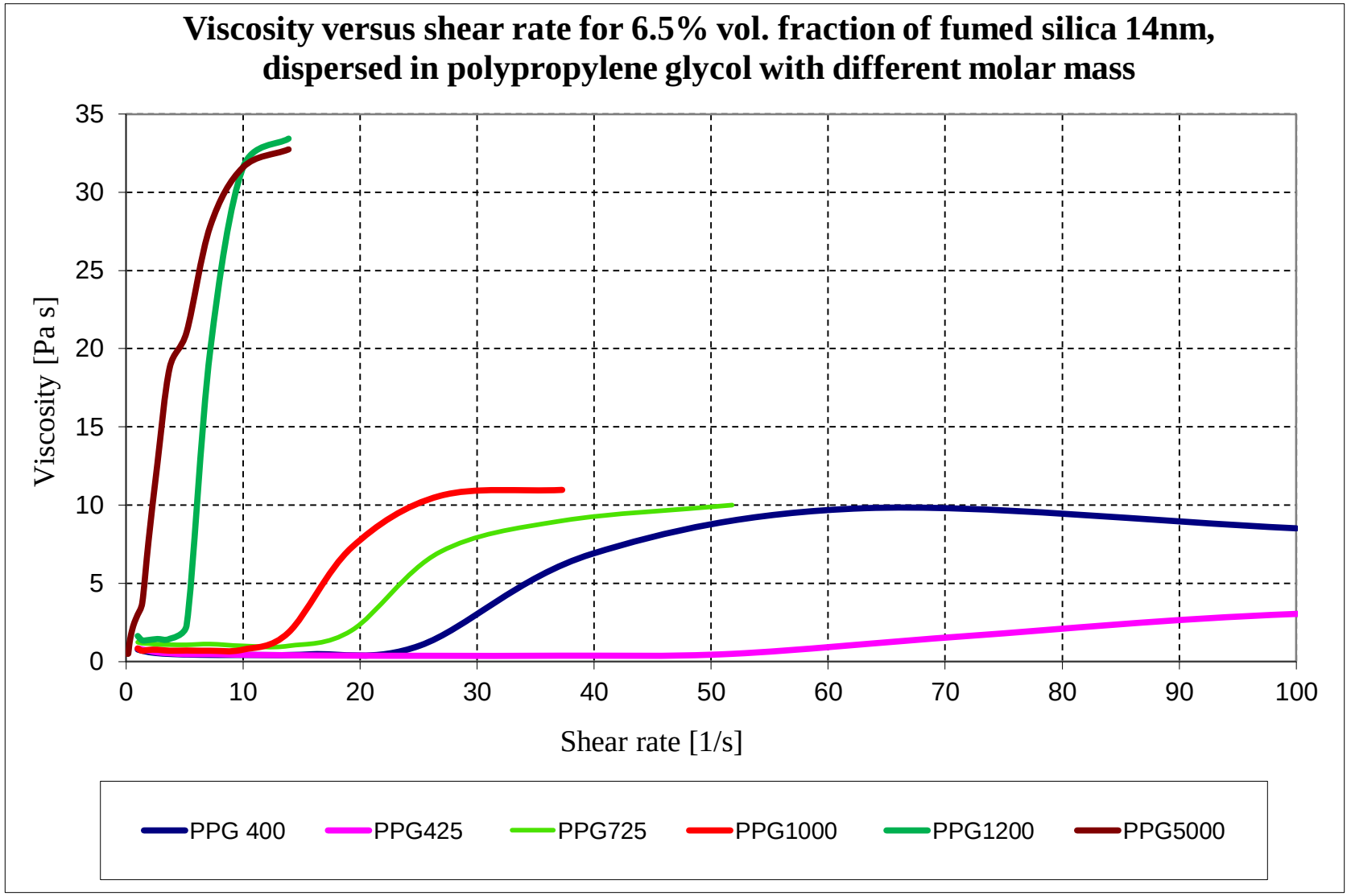
Silica	Trade name	Density [g/cm^3]	Average particle size [nm]	Surface area BET [m^2/g]
FS7	*Fumed silica*	1,53	7	390 ± 40
FS14	*Fumed silica*	1,53	14	200 ± 25

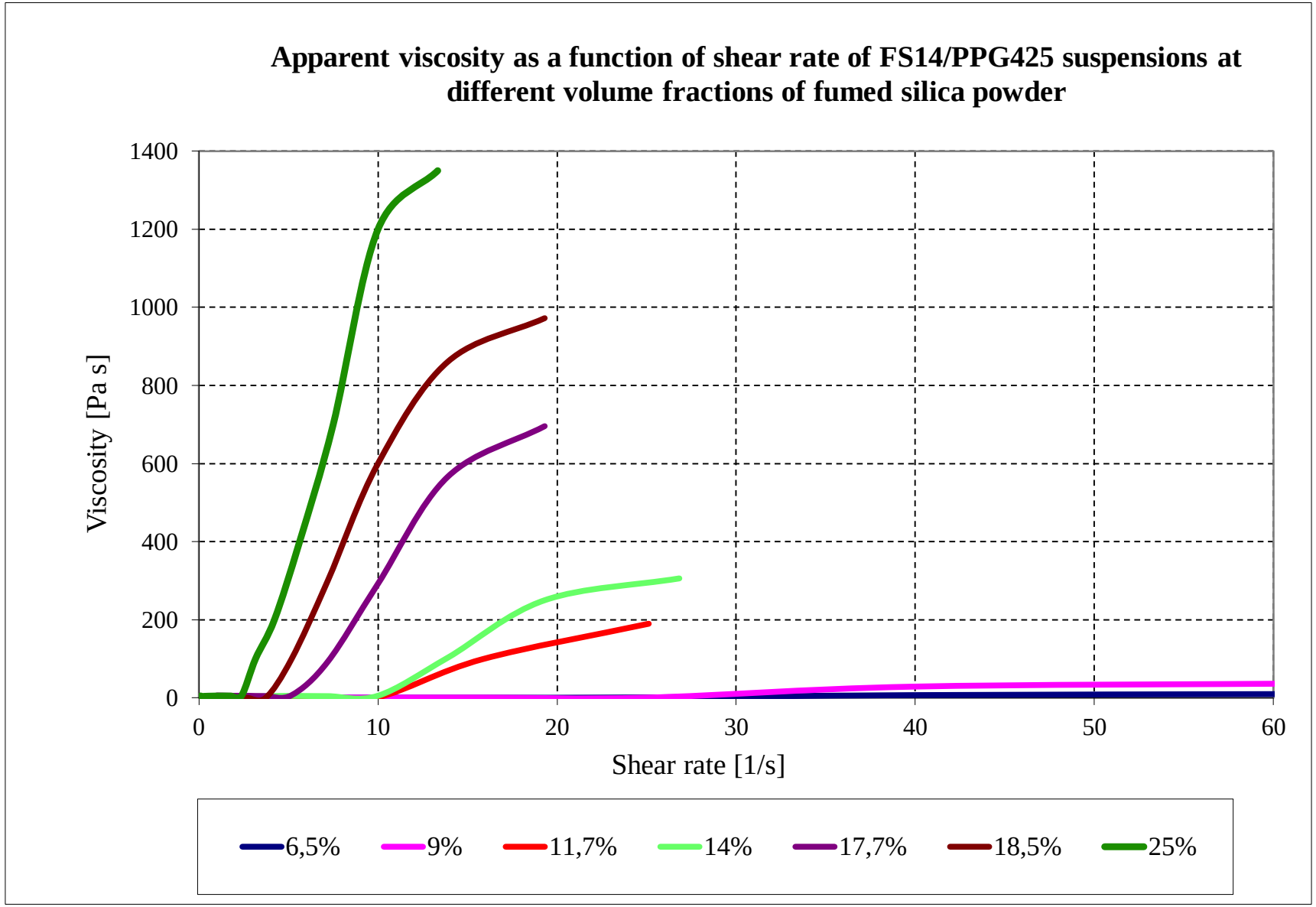
Expanded microspheres

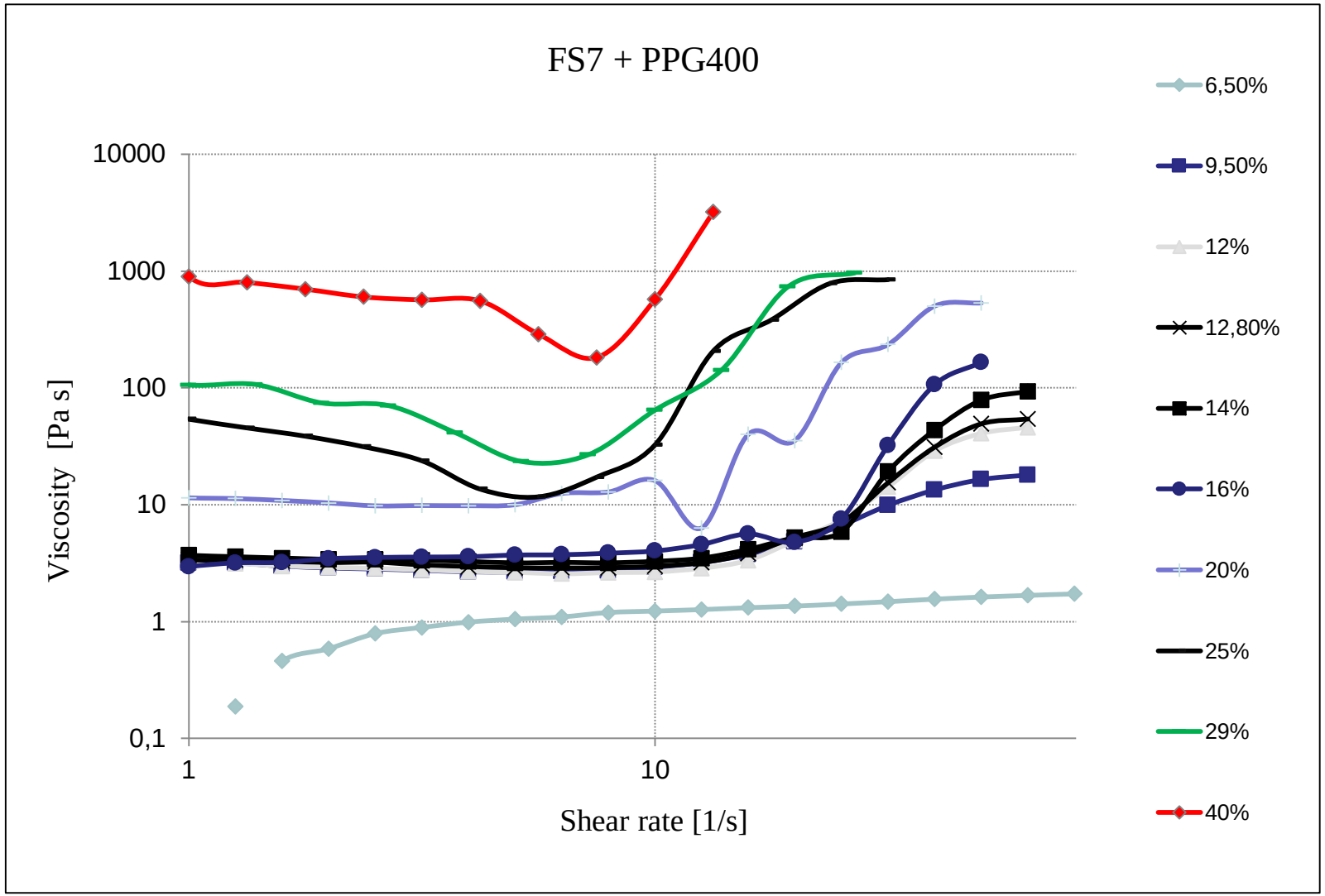


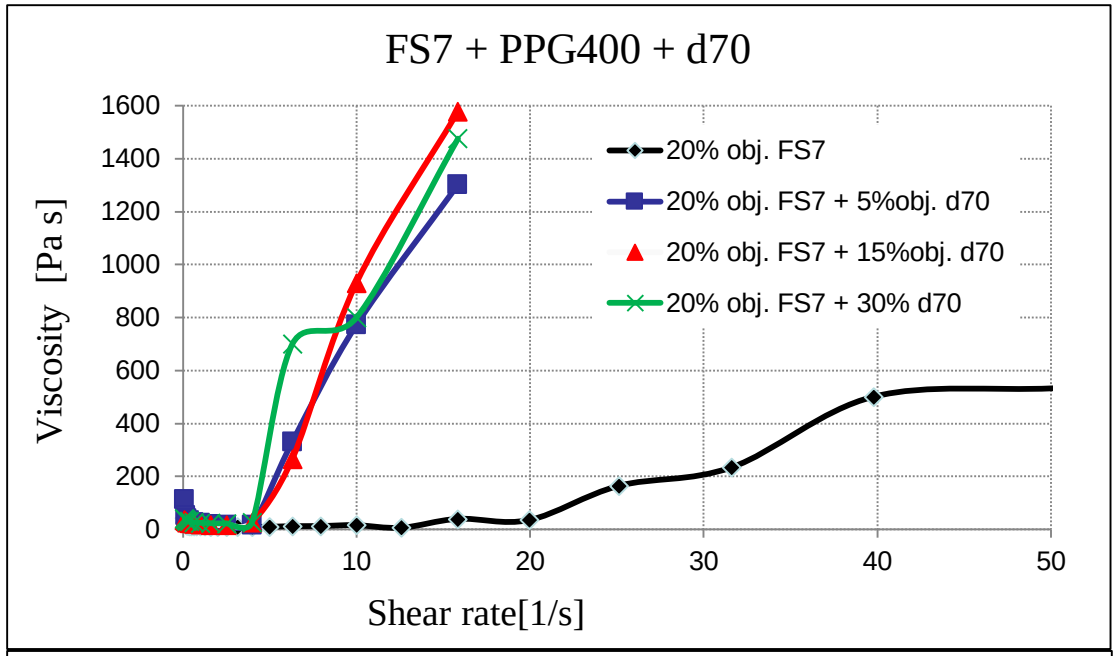
Manufacturer	Trade name	Density [g/cm^3]	Average particle size [µm]
AkzoNobel	*M20d70*	0,07±0,006	15-25
AkzoNobe	*M80d30*	0,03±0,003	55-85

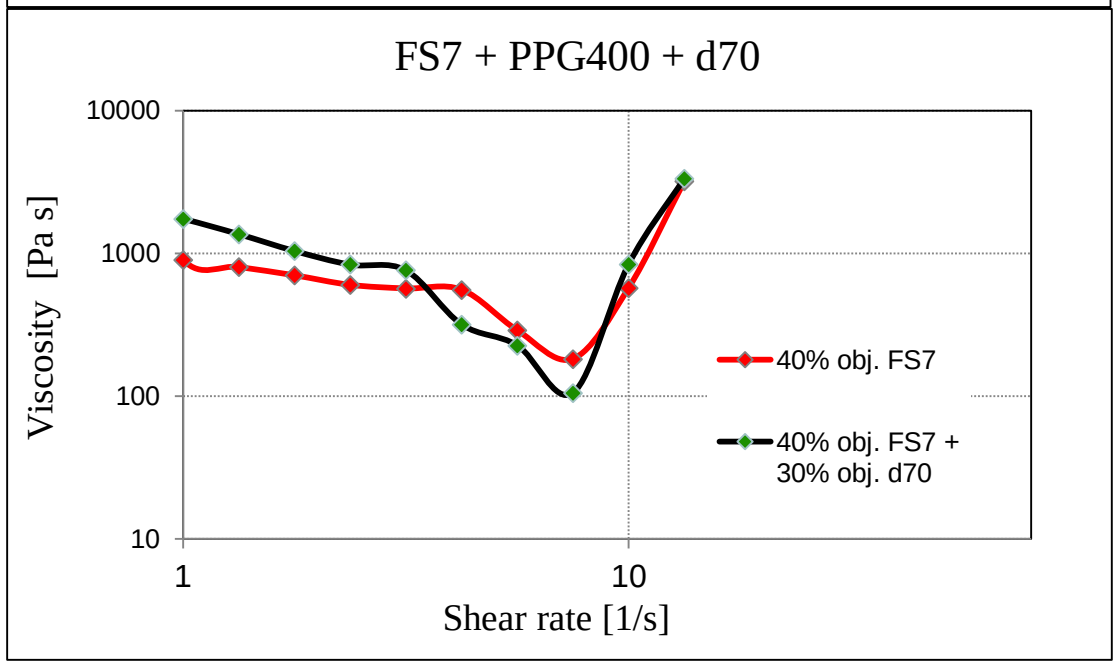

Viscosity versus shear rate for 14% vol. fraction of fumed silica 14nm, dispersed in different types of dispersing media
Viscosity [Pa*s]
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Shear rate [1/s]
Ethylene glycol
polyethylene glycol 200
Dipropylene glycol
Polypropylene glycol 725


Viscosity versus shear rate for 6.5% vol. fraction of fumed silica 14nm, dispersed in polypropylene glycol with different molar mass
Viscosity [Pa s]
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
Shear rate [1/s]
PPG 400
PPG425
PPG725
PPG1000
PPG1200
PPG5000


Apparent viscosity as a function of shear rate of FS14/PPG425 suspensions at different volume fractions of fumed silica powder
Viscosity [Pa s]
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
Shear rate [1/s]
6,5%
9%
11,7%
14%
17,7%
18,5%
25%


FS7 + PPG400
Viscosity [Pa s]
10000
1000
100
10
1
0,1
1
10
Shear rate [1/s]
6,50%
9,50%
12%
12,80%
14%
16%
20%
25%
29%
40%





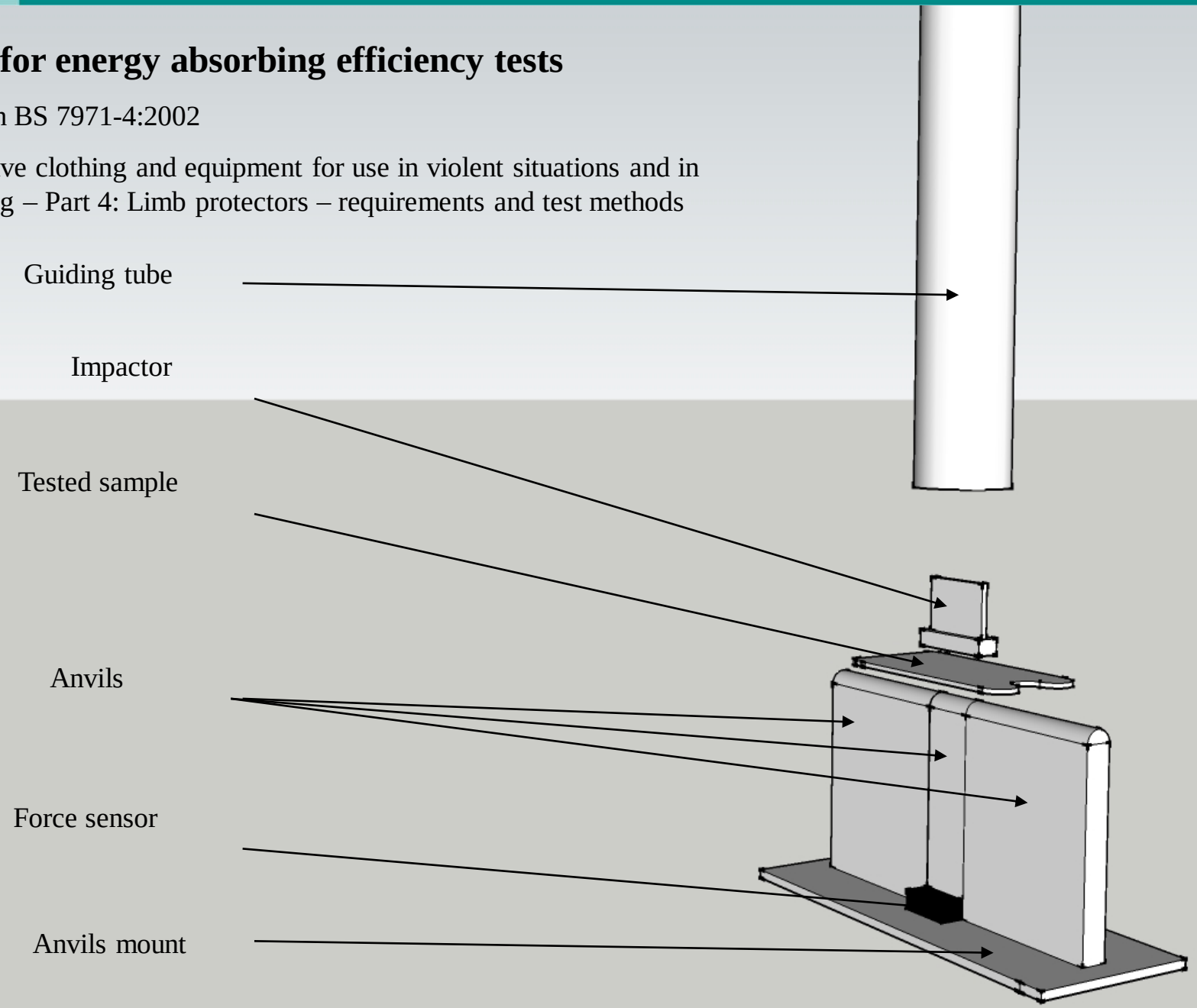
Shear thickening fluid based on PPG400	Vol. fraction of expanded microspheres d70 [%]	Density [g/cm^3]
FS7 20%	0	1,31
FS7 20% d70 5%	5	1,26
FS7 20% d70 15%	15	1,15
FS7 20% d70 30%	30	1,03
FS7 40%	0	1,62
FS7 40% d70 30%	30	1,27

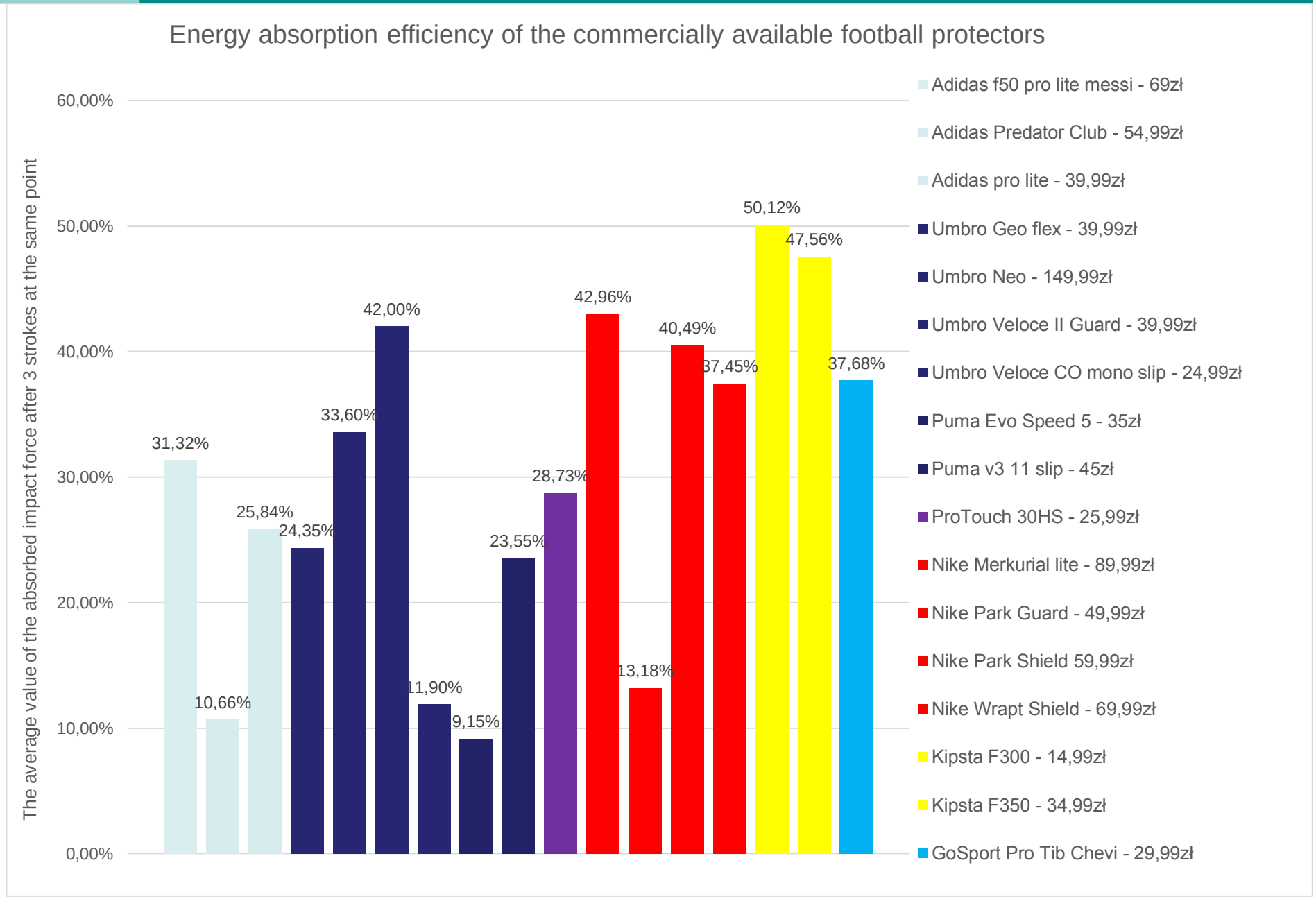
Patent pending
P.405332 z 13.09.2013, „Dylatancyjna zawiesina ceramiczna i zastosowanie”

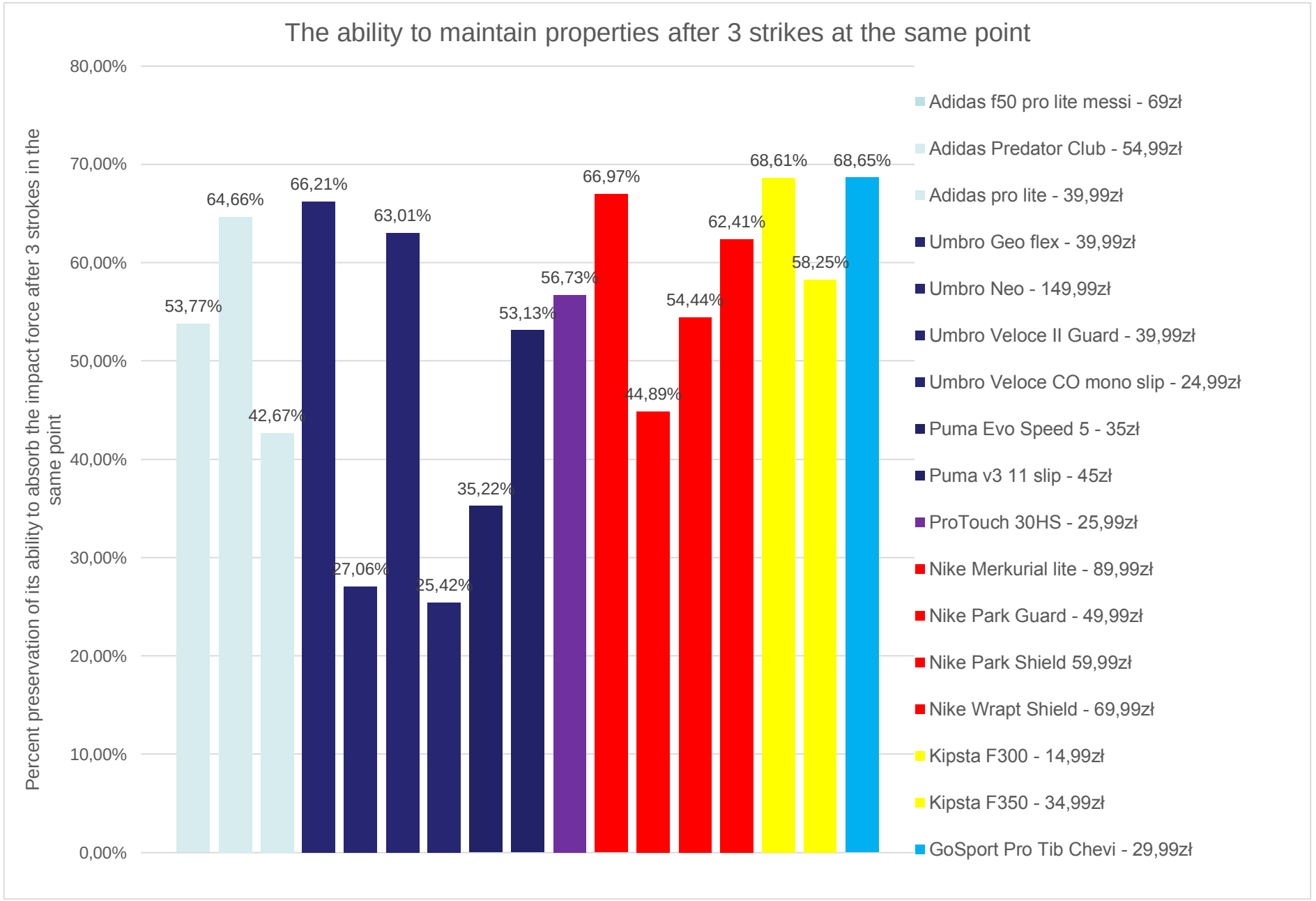
Stand for energy absorbing efficiency tests

based on BS 7971-4:2002

Protective clothing and equipment for use in violent situations and in training – Part 4: Limb protectors – requirements and test methods




Energy absorption efficiency of the commercially available football protectors
The average value of the absorbed impact force after 3 strokes at the same point
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
31,32%
10,66%
25,84%
24,35%
33,60%
42,00%
11,90%
9,15%
23,55%
28,73%
42,96%
13,18%
40,49%
37,45%
50,12%
47,56%
37,68%
Adidas f50 pro lite messi - 69zł
Adidas Predator Club - 54,99zł
Adidas pro lite - 39,99zł
Umbro Geo flex - 39,99zł
Umbro Neo - 149,99zł
Umbro Veloce II Guard - 39,99zł
Umbro Veloce CO mono slip - 24,99zł
Puma Evo Speed 5 - 35zł
Puma v3 11 slip - 45zł
ProTouch 30HS - 25,99zł
Nike Merkurial lite - 89,99zł
Nike Park Guard - 49,99zł
Nike Park Shield 59,99zł
Nike Wrapt Shield - 69,99zł
Kipsta F300 - 14,99zł
Kipsta F350 - 34,99zł
GoSport Pro Tib Chevi - 29,99zł


The ability to maintain properties after 3 strikes at the same point
Percent preservation of its ability to absorb the impact force after 3 strokes in the same point
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
53,77%
64,66%
42,67%
66,21%
27,06%
63,01%
25,42%
35,22%
53,13%
56,73%
66,97%
44,89%
54,44%
62,41%
68,61%
58,25%
68,65%
Adidas f50 pro lite messi - 69zł
Adidas Predator Club - 54,99zł
Adidas pro lite - 39,99zł
Umbro Geo flex - 39,99zł
Umbro Neo - 149,99zł
Umbro Veloce II Guard - 39,99zł
Umbro Veloce CO mono slip - 24,99zł
Puma Evo Speed 5 - 35zł
Puma v3 11 slip - 45zł
ProTouch 30HS - 25,99zł
Nike Merkurial lite - 89,99zł
Nike Park Guard - 49,99zł
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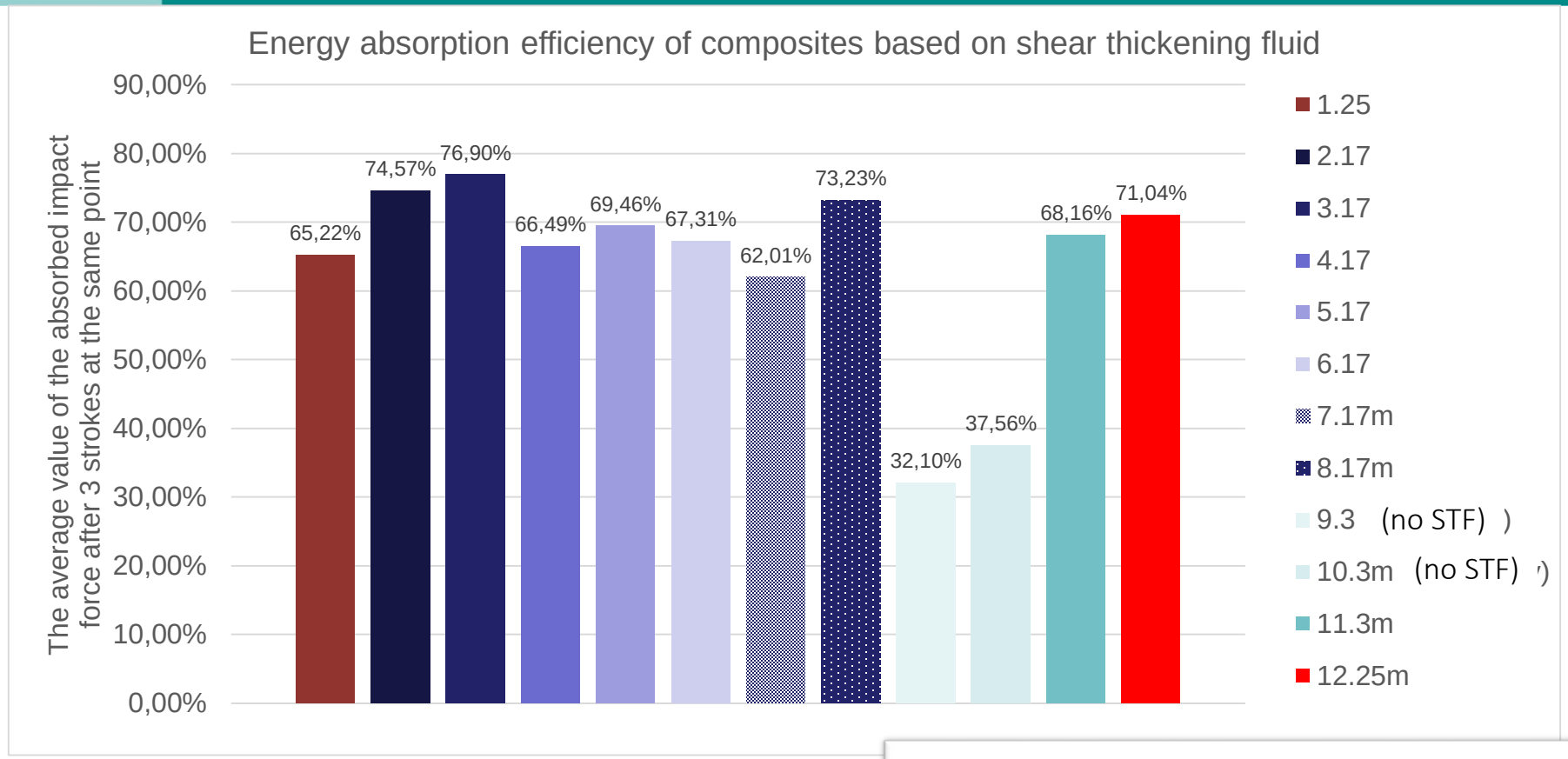
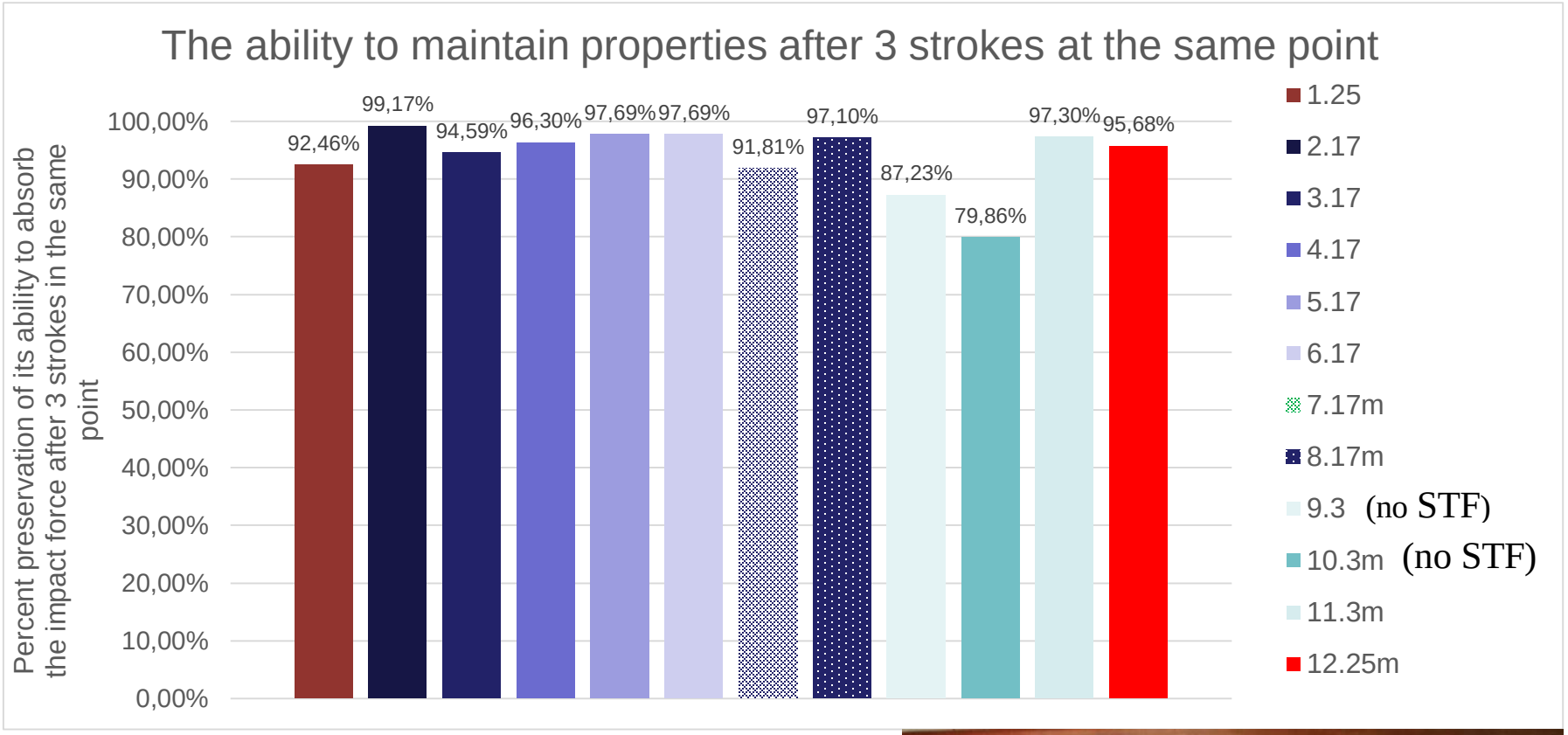
Kipsta F350 - 34,99zł
GoSport Pro Tib Chevi - 29,99zł



The sheen protectors were built of pockets with STF, embedded in 3D fabrics and polyurethane foams of various density (48, 270 and 400 kg/m^3) and covered by various fabrics.



The best stability of the energy absorption properties (99.17%) was obtained for the prototype based on polyurethane foam having density of 270 kg/m^3.

Smart body armour based on shear thickening fluid

Certified by the Military Institute of Armament Technology according to PN-V-87000: 2011 standard (K1 A class). REA inserts size was 360x300 mm. Before the ballistic tests, the specimens were hold under four different environmental conditions. Each sample was hit with 6 bullets of FMJ Parabellum 9 mm (377÷388 m/s). 4 shots were taken perpendicularly to the plane of samples, and 2 of them were taken at the angle of 30°

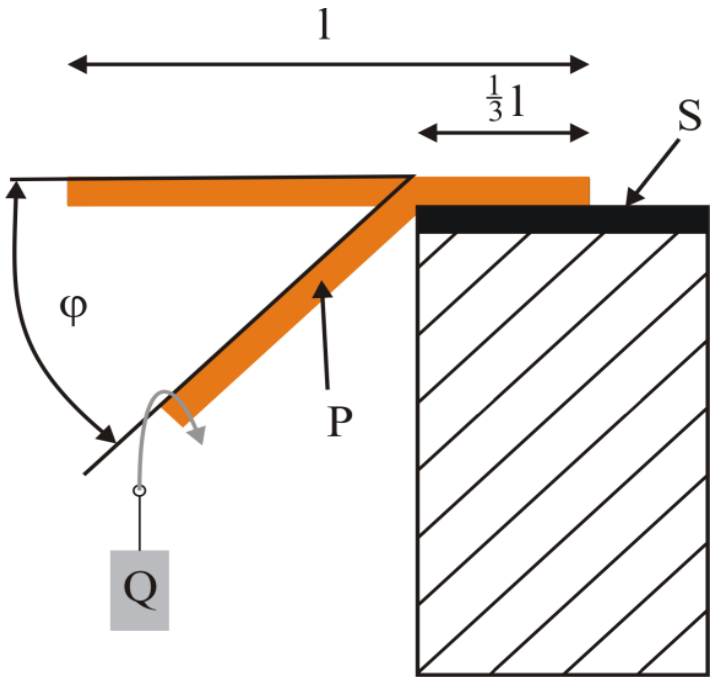
Tested Specimen	Areal density [kg/m^2]	Thickness [mm]	Average backface signature depth after 6 shots [mm]	Perforation Yes/No
Kevlar XP307	5,87	9,3 ± 0,5	18,7	No
REA	5,65	8 ± 0,5	17,3	No
REA after sprinkling	5,64	8 ± 0,5	18,8	No
REA temp. +50°C	5,61	8 ± 0,5	20,6	No
REA -40°C	5,6	8 ± 0,5	16,8	No

Passage of time was simulated in accelerate aging chamber according to the Military Institute of Armament Technology standard.

After accelerate aging each sample was hit with 6 bullets of FMJ Parabellum 9 mm (350÷380 m/s), under different environmental conditions according to PN-V-87000: 2011 standard (K1 A class).

REA	Areal density [kg/m^2]	Thickness [mm]	Average backface signature depth after 6 shots [mm]	Perforation Yes/No
after sprinkling	5,6	8 ± 0,5	15,5	No
temp. +50°C	5,62	8 ± 0,5	17,5	No
temp. -40°C	5,63	8 ± 0,5	14,2	No

Flexibility tests



Tested specimen	Areal density [kg/m²]	Deflection angle [°]	Thickness [mm]	Average backface signature depth after 6 shots [mm]
Kevlar XP307	5,87	55	9,3 ± 0,5	18,7
REA	5,65	80	8 ± 0,5	17,3

Other applications

Sport

Medicine

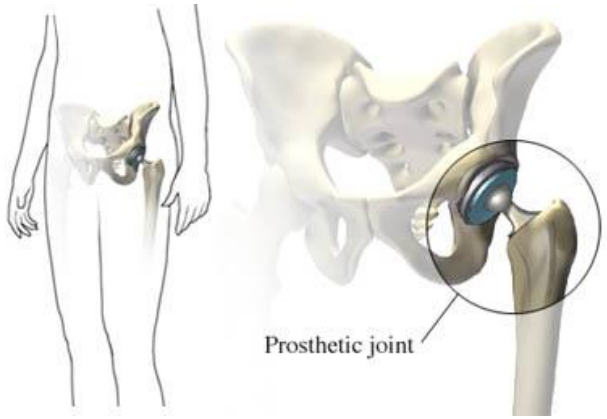
Construction

Automotive

Transport

Telecommunication

http://pacauto.com



http://www.symptomlog.com

http://garneczki.pl

www.insportline.eu

www.sputniksnowboardshop.com

www.vegacom.eu

http://www.vncegroup.com

Thank you for your attention!

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

Nanostructures in semiconductors and ceramics

B. Pécz
MTA EK MFA, 1121 Budapest, Konkoly-Thege M. u. 29-33, Hungary

The Joint Visegrad 4 – Japan Seminar on Technology Transfer – Nanomaterials for Industrial Use, Tokyo, Japan, 16th June 2016

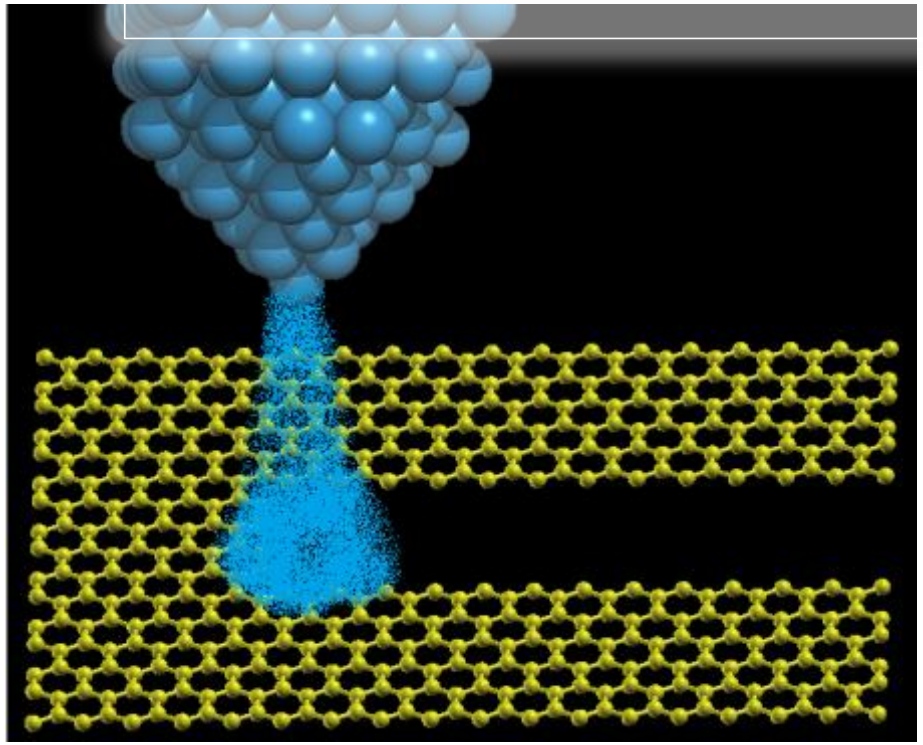
Hungarian Academy of Sciences, Centre for Energy Research (EK)

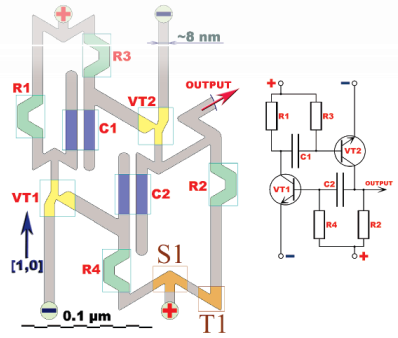
Institute for Technical Physics and Materials Science (MFA)

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

Graphene and other 2D materials

Scanning Tunneling Microscope Lithography





Key advantages over state-of-the-art

The most precise nanofabrication technique for graphene

Full control of the crystallographic edge orientation

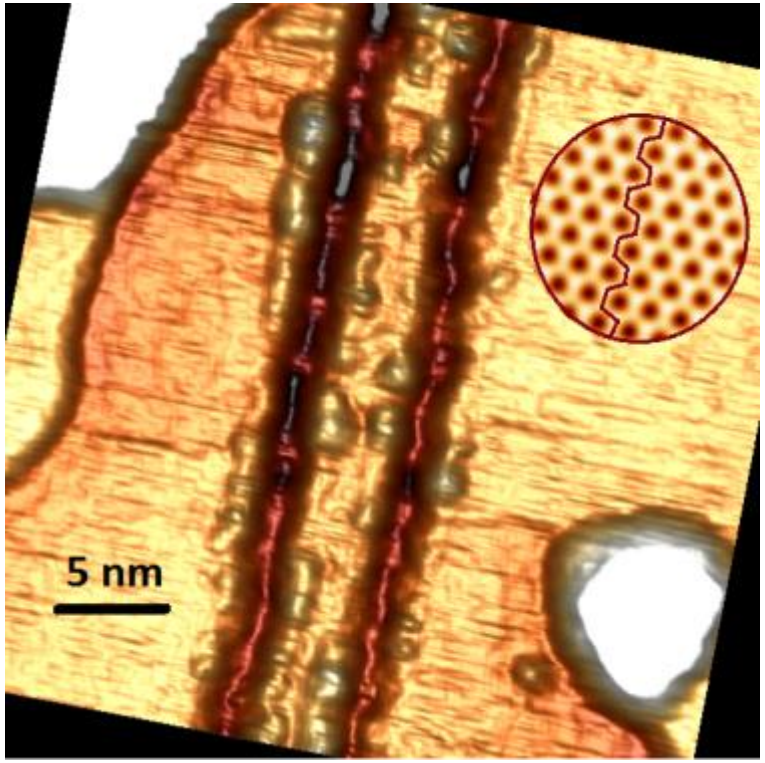
Fabrication of complex all-graphene circuits with atomically perfect interconnections

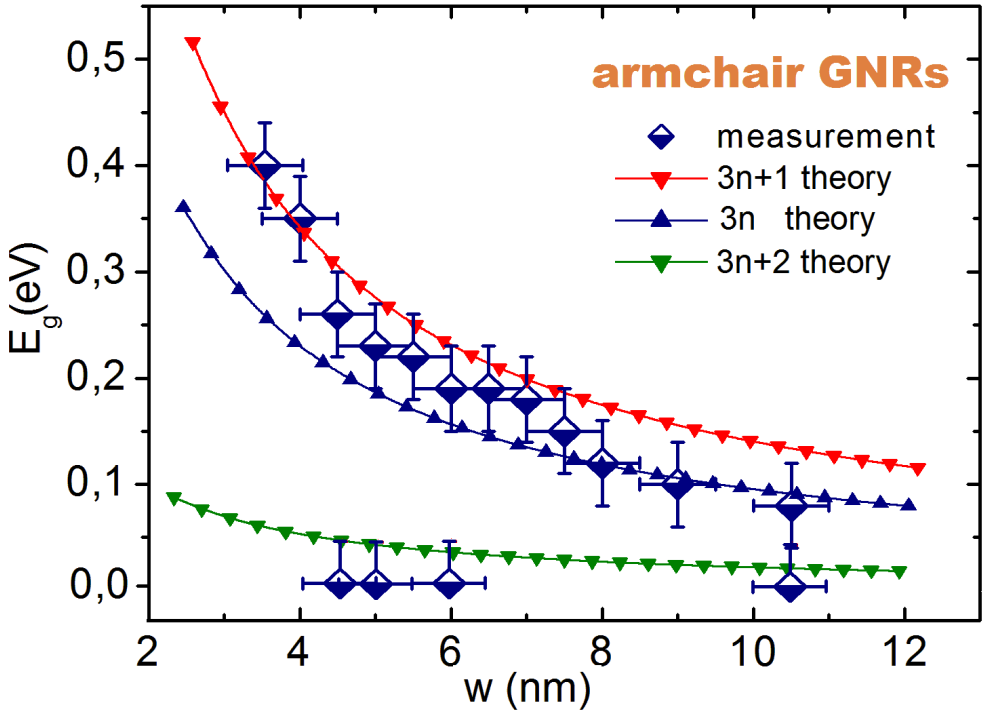
$$C_6 + 2H_2O \xrightarrow{adsorp} C_6(2H_2O) \xrightarrow{tunnel.curr.} [C_6(4H + 2O)] \xrightarrow{chem.react.} 2(CO)\uparrow + 4CH(edge)$$

L. Tapasztó et al. Nature Nanotechnology 3, 397 (2008)

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

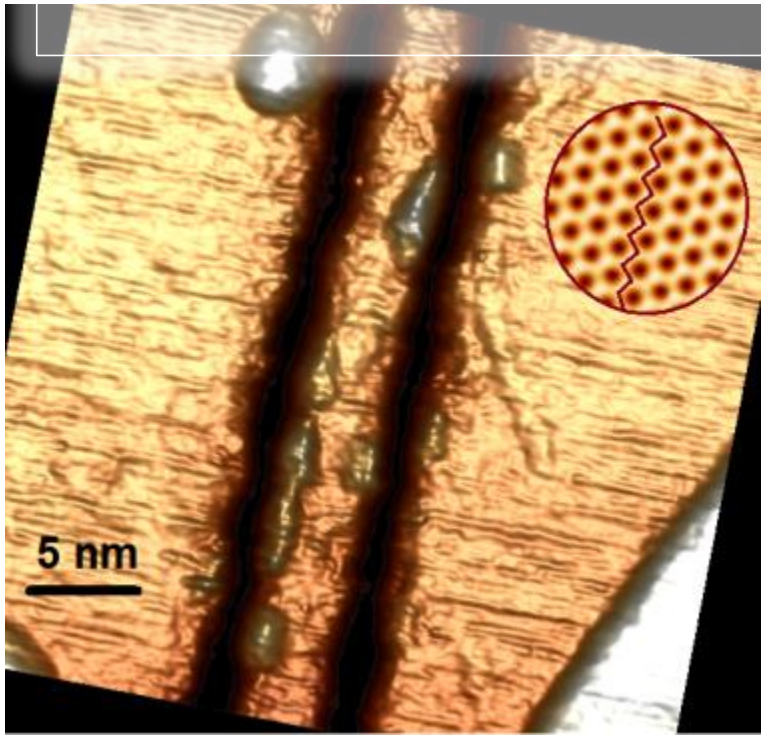
Bandgap engineering in armchair graphene nanoribbons

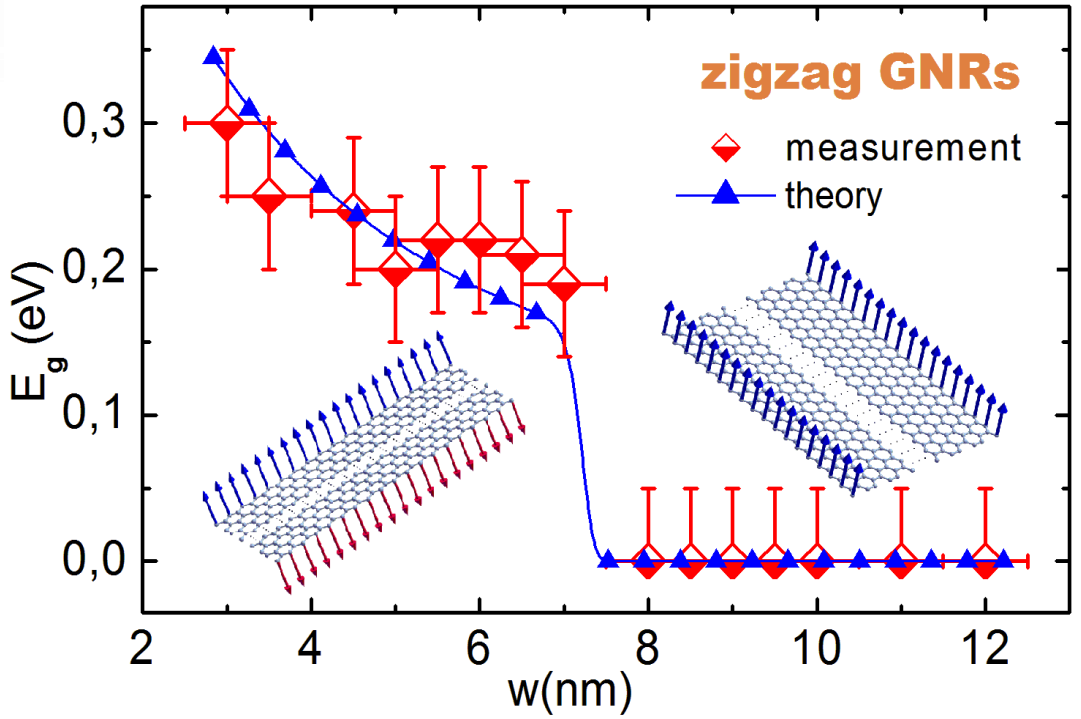




G.Z. Magda et al. ***Nature***, **514**, 608-611 (**2014**)

Edge magnetism in zigzag graphene nanoribbons



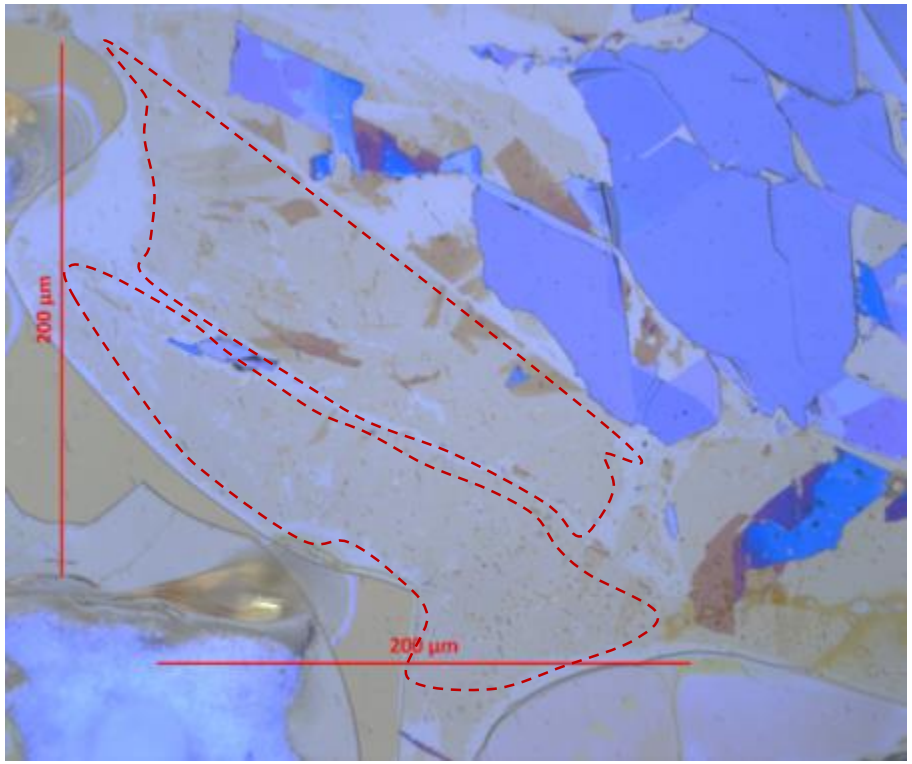


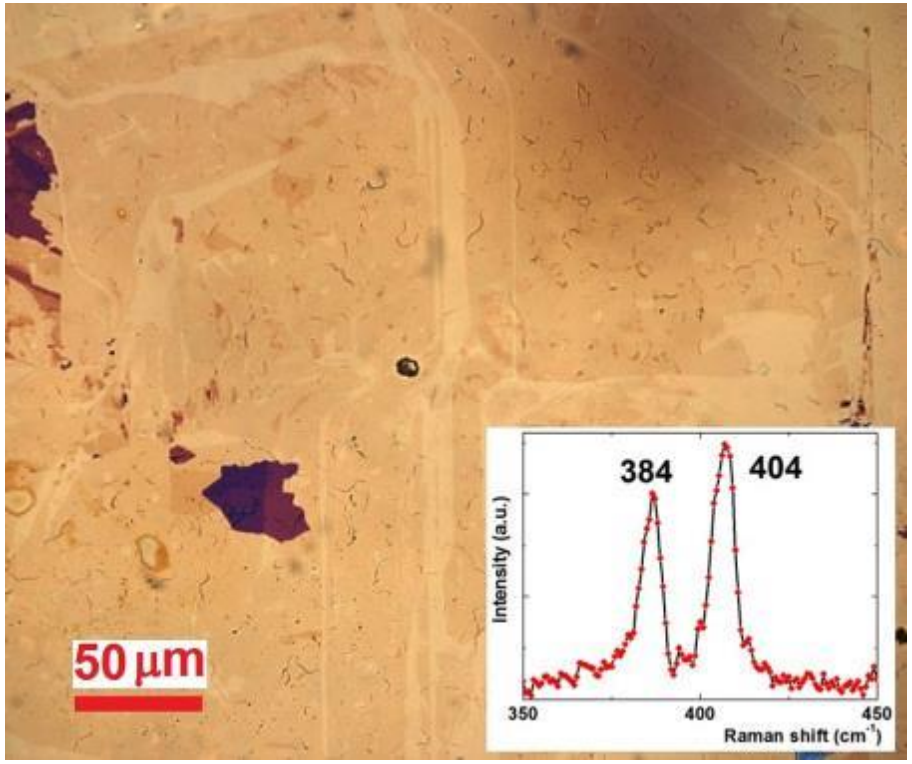
G.Z. Magda et al. ***Nature***, **514**, 608-611 (**2014**)

$$\mathcal{H} = -\sum_{\langle i,j \rangle} t_{ij} \hat{c}^{\dagger}_{i\sigma} \hat{c}_{j\sigma} + U \sum_{j} \hat{n}_{j\uparrow} \hat{n}_{j} - \mu \hat{N}$$

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

Exfoliation of large-area MoS_2 single layers to Au(111)



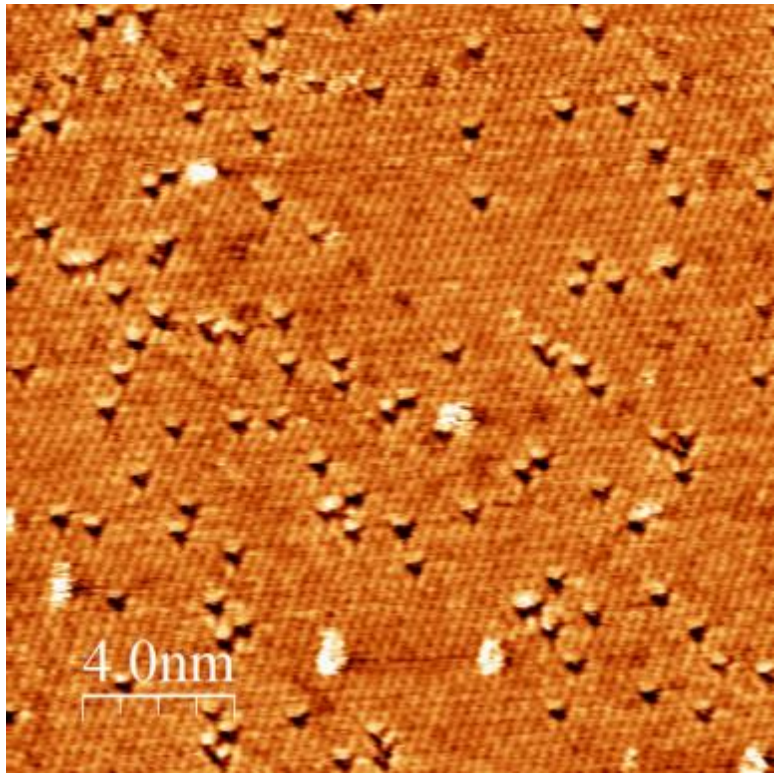


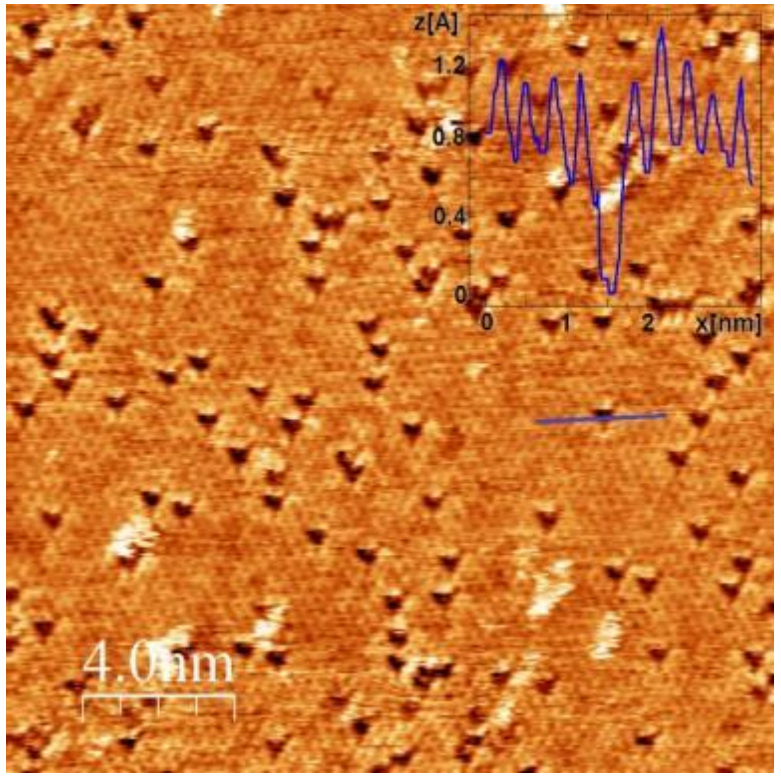
Our novel exfoliation method based on chemically enhanced adhesion to Au (111) yields hundreds of microns lateral size MoS_2 single layers

G. Z. Magda et al. *Scientific Reports 5, 14714 (2015)*

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

Atomic resolution of native defects of MoS_2 single layers



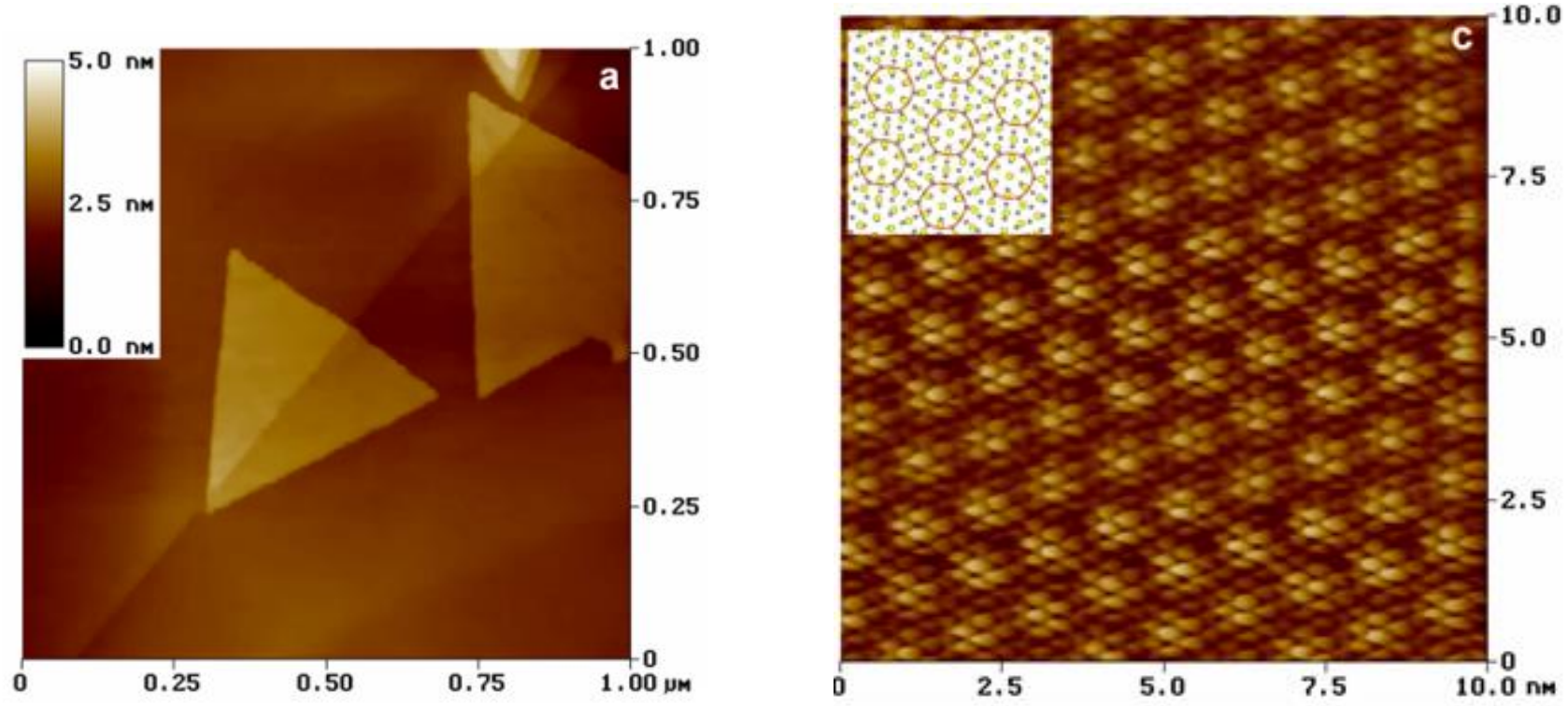


Atomic resolution STM images of native point defects in exfoliated MoS_2 single layers.
High native defect density: 10^{13} cm^{-2}

G. Z. Magda et al. *Scientific Reports, in press*

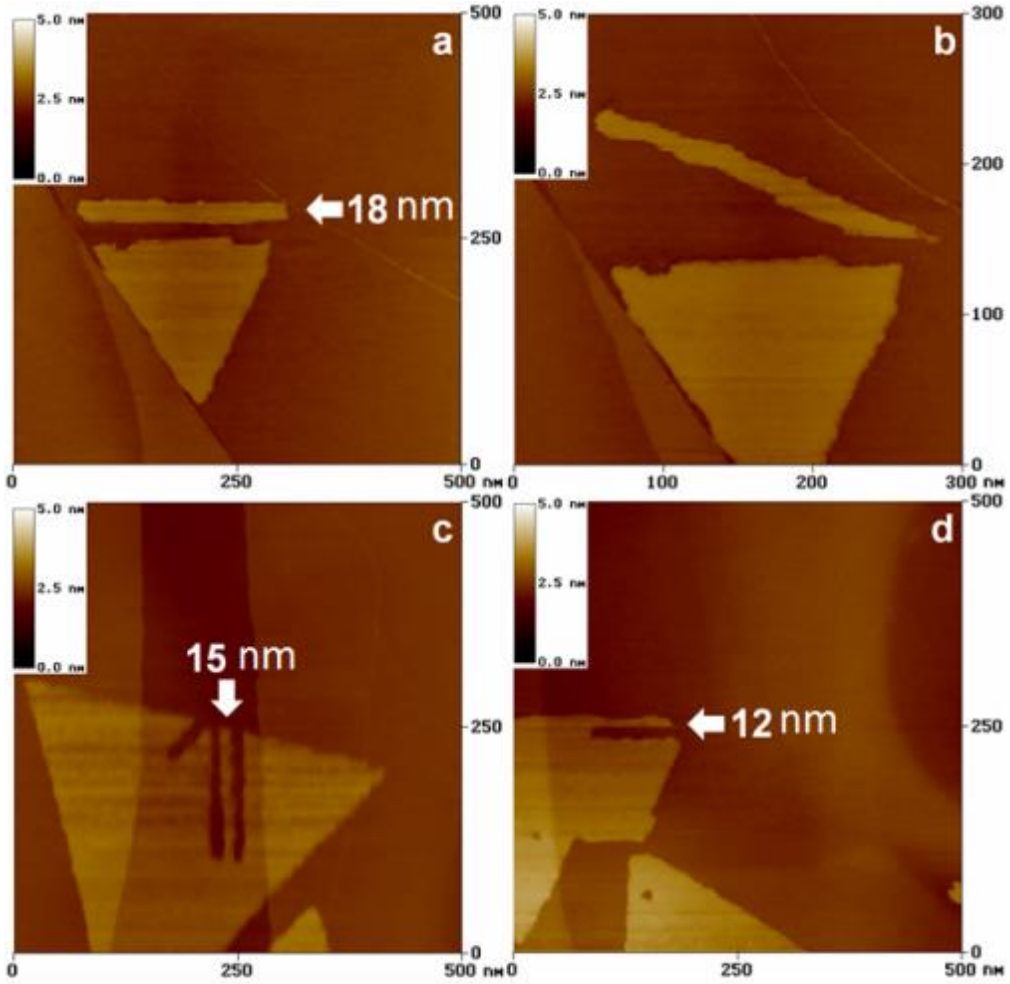
Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

CVD growth of MoS_2 on HOPG substrate



A.A. Koos et al, *Carbon, in press*

STM lithography of MoS_2 nanoribbons



A.A. Koos et al, *Carbon, in press*

Silicon Nitride Composites with Different Nanocarbon Additives

AIM of work

M-ERANET „GRACE" (2015 – 2017)

The investigation of the influence of the different ***processing routes*** and the addition of nanocarbon additives (graphene, carbon nanotubes) on ***structure***, fracture toughness and the ***toughening mechanisms*** of Si_3N_4 based composites as ***components for tribological application in aqueous environments***.

PROCESSING route

90%wt α-Si_3N_4 +
4 wt% Al_2O_3 +
6 wt% Y_2O_3 +
Carbon addition

→ Attritor milling 4000 rpm/5h + 0.5h with graphene

→ - polyethylenglycol, PEG
- drying
- sieving
- dry pressing

→ Hot isostatic pressing (HIP) Spark plasma sintering (SPS)

HIP

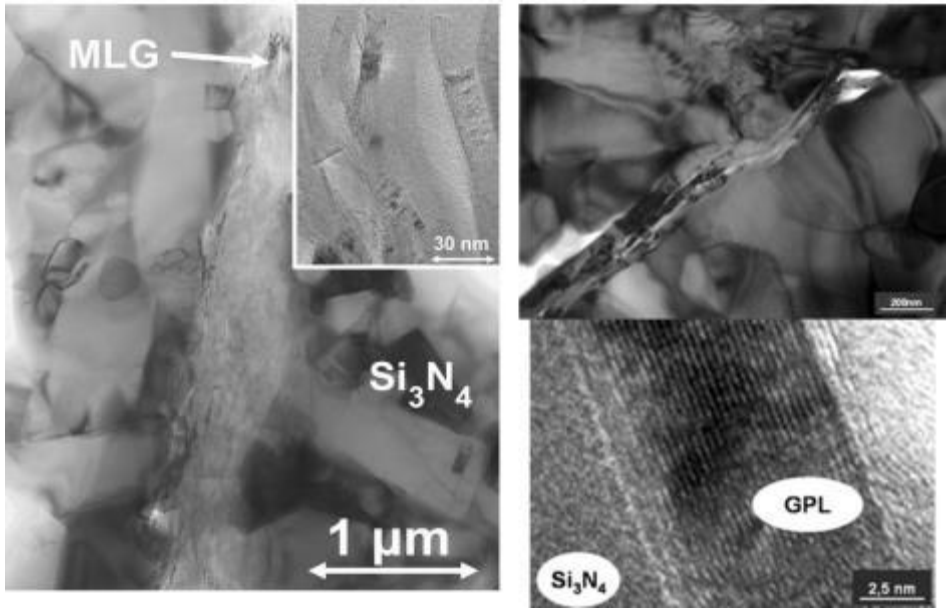
SPS

Balázsi Cs, et al., *MAT SCI ENG C* 23:(6-8) (2003) 1133-1137

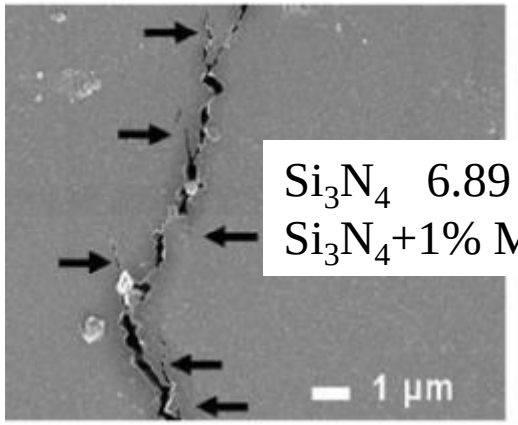
O. Tapasztó, Cs. Balázsi, *Ceram Int* 36 (2010) 2247-2251

O. Tapasztó, et al. *Chem Phys Lett* 511 (2011) 340-343

STRUCTURE and TOUGHENING mechanism



Increasing of fracture toughness

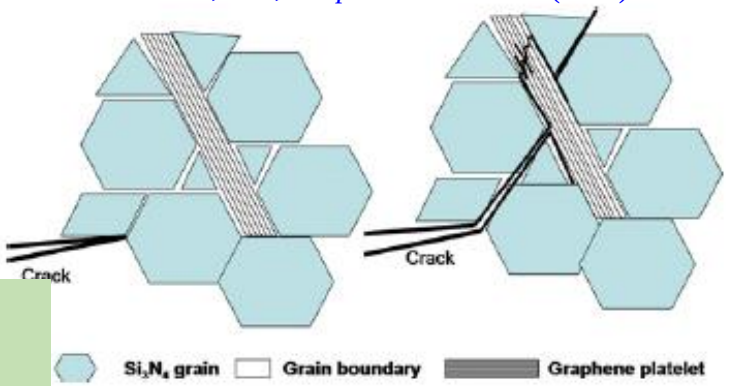


K_{IC} ($MPa.m^{0.5}$)

Si_3N_4 6.89 ± 0.39

Si_3N_4+1% MLG 9.92 ± 0.38

Kvetkova L., et al, *Scripta Materialia* 66 (2012) 793–796



APPLICATIONS

Si_3N_4 + 3wt% **CNT**

Bending strenght 700 Mpa

Electrical conductivity 10 S/m

Ceramic components for tribological application

safe+most

JST-V4 project: SAFEMOST

“Highly Safe GaN Metal-Oxide-Semiconductor”

Participants:

- Institute of Electrical Engineering (Slovak Academy of Sciences, Bratislava, Slovakia)
- Research Center for Integrated Quantum Electronics (Hokkaido University, Sapporo, Japan)
- Institute of Physics – Centre for Science and Education (Silesian University of Technology, Gliwice, Poland)
- Institute of Technical Physics and Materials Sciences (Centre for Energy Research, Hungarian Academy of Sciences, Budapest, Hungary)

Duration: 01.01.2016 – 31.12.2018

Coordinator: Dr. Jan Kuzmik, Bratislava

Financing is done by the funding agencies of the individual countries and the International Visegrad Fund.

The role of our Institute is the TEM characterization of the deposited films and to give feedback for the partners on the defects observed.

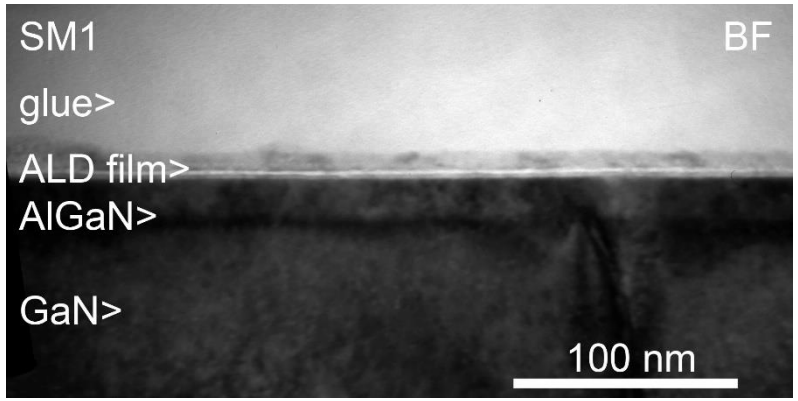
JST

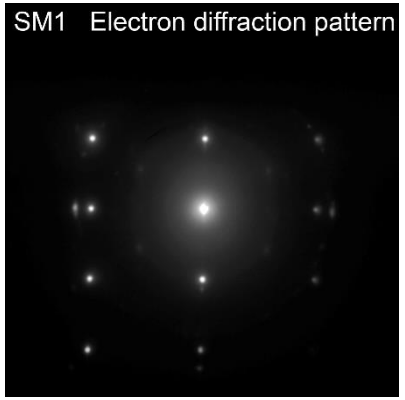
NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION OFFICE

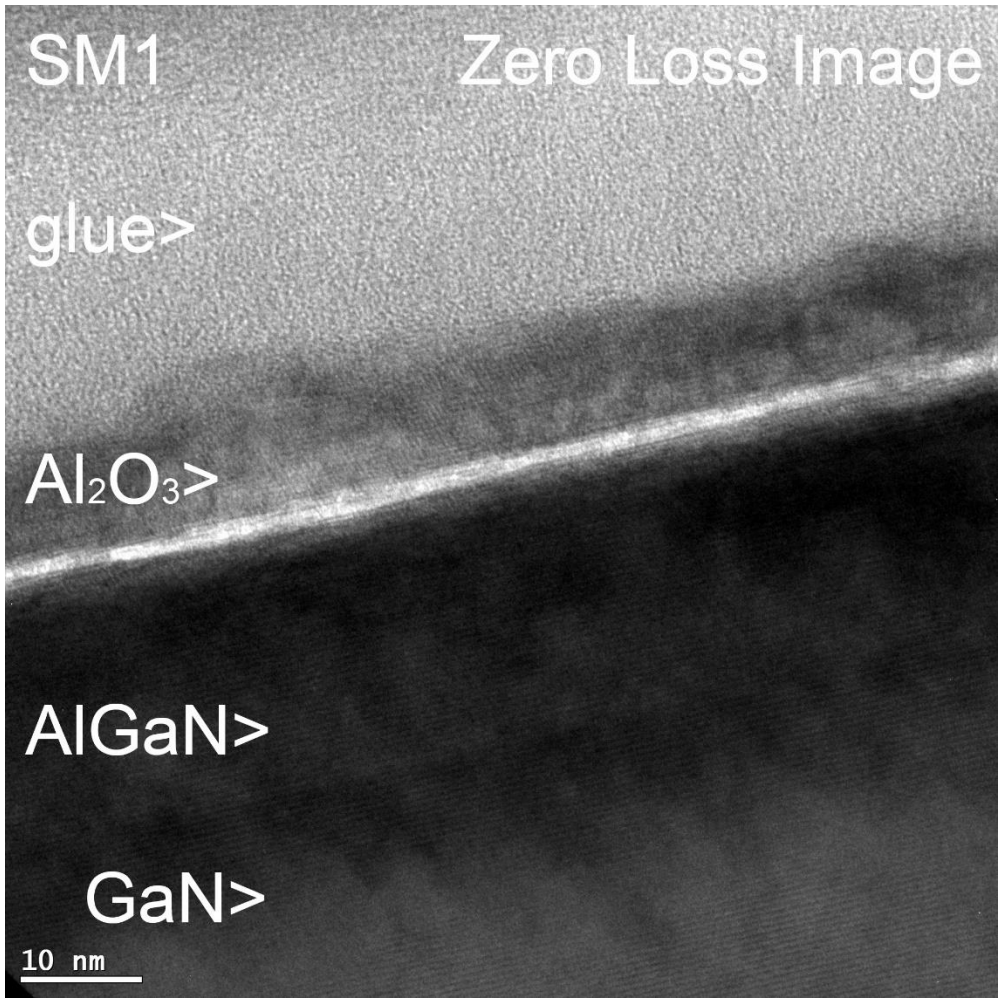
Visegrad Fund

Hungarian Academy of Sciences, Centre for Energy Research (EK)
Institute for Technical Physics and Materials Science (MFA)

SAFEMOST project: Thin gate-oxide by ALD







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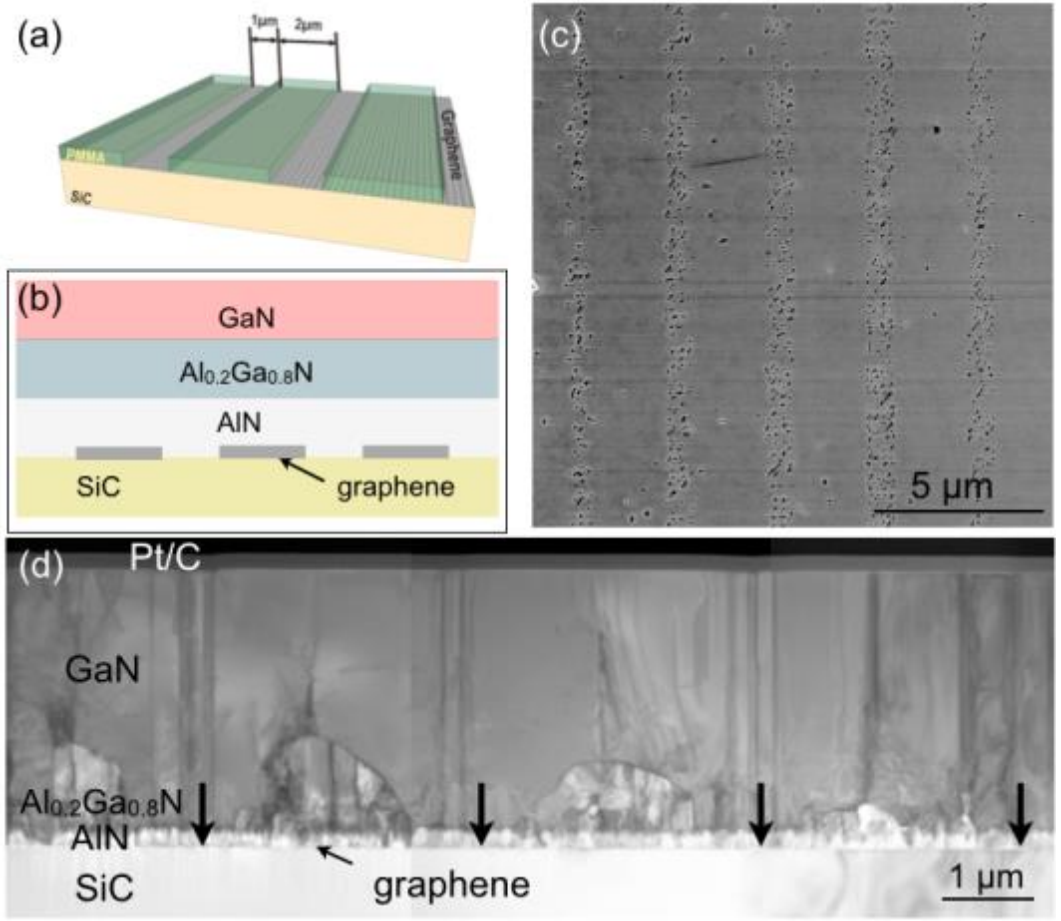


smooth surface

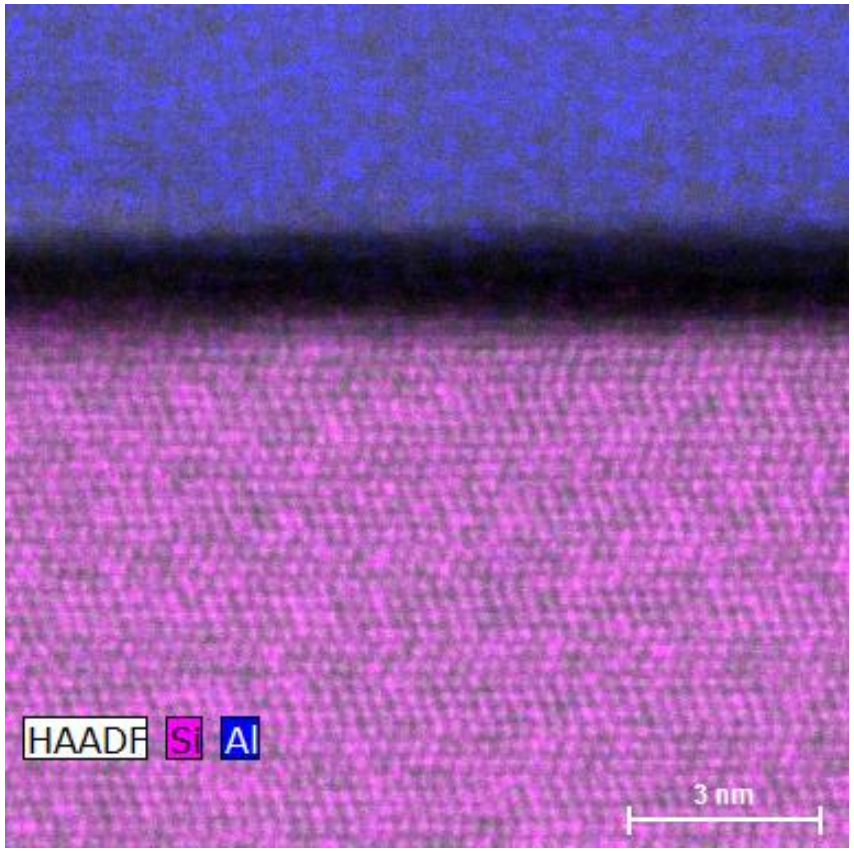
dislocation density
~3 x 10^9 cm^{-2}

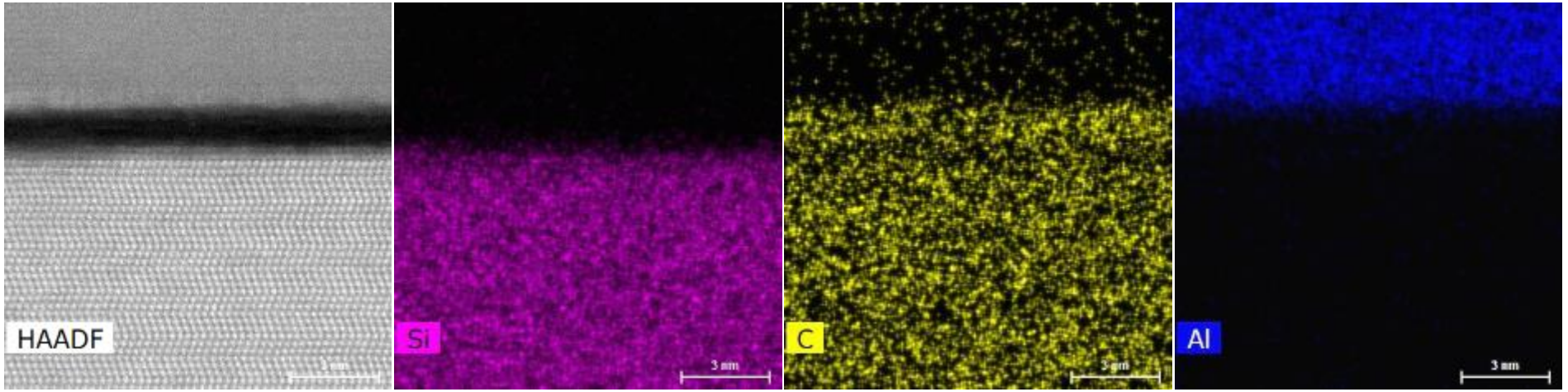
integration of graphene sheets into nitride devices

A. Kovács, M. Duchamp, R.E. Dunin-Borkowski, R. Yakimova, P. L. Neumann, H. Behmenburg, B. Foltynski, C. Giesen, M. Heuken and B. Pécz**:** Graphoepitaxy of High-Quality GaN Layers on Graphene/6H–SiC, Advanced Materials Interfaces, 2 (2015) DOI: 10.1002/admi.201400230

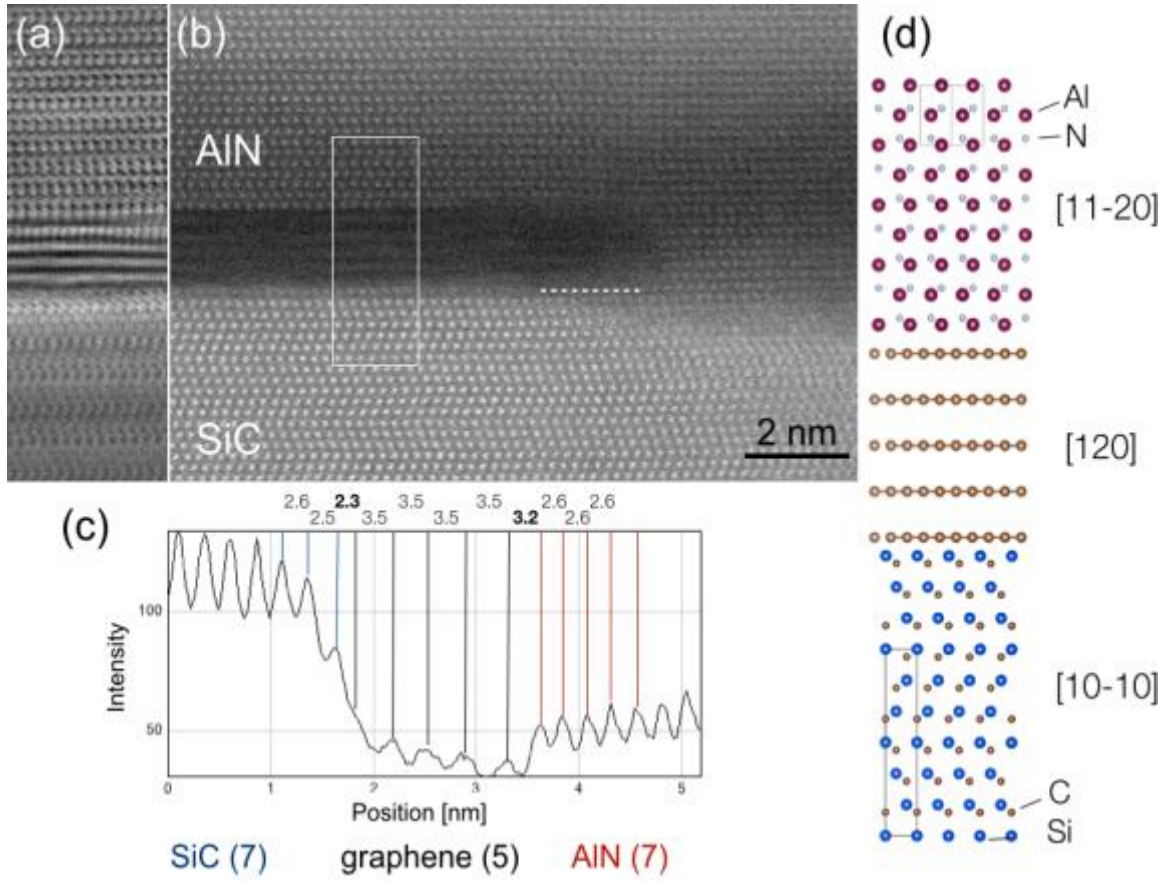
AlN growth on <u>continuous</u> graphene

Al and Si EDXS maps superimposed onto a HAADF STEM image





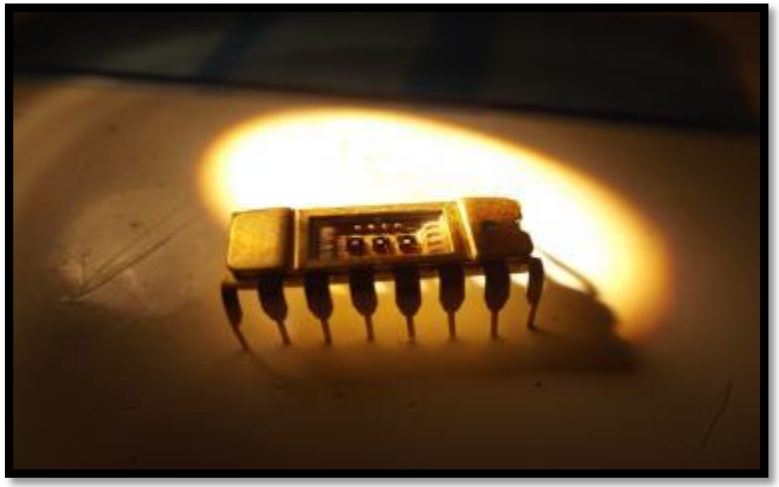
HAADF STEM image, Si, C and Al EDXS maps recorded using a FEI Titan ChemiSTEM at 200 kV.

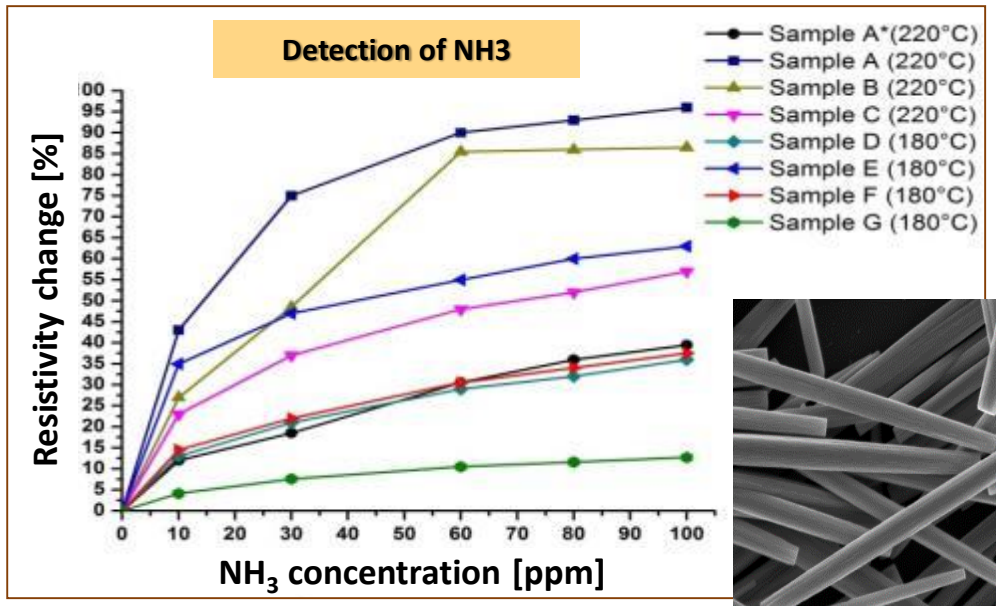


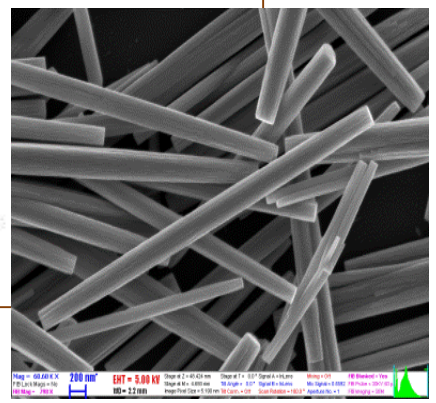
typically 3 layers of graphene, but sometimes 5 are observed

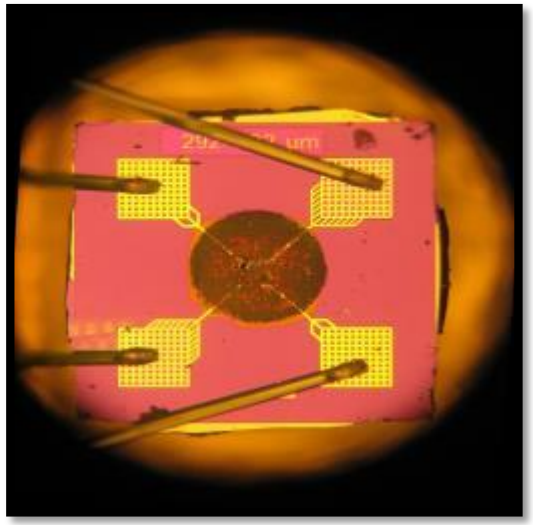
Pellistor and Taguchi type solid state gas sensors

Wet chemical deposition of WO_3 sensing layer







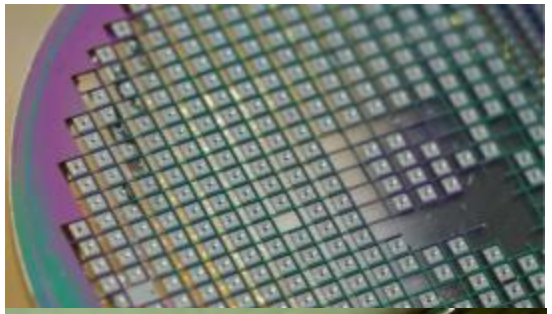


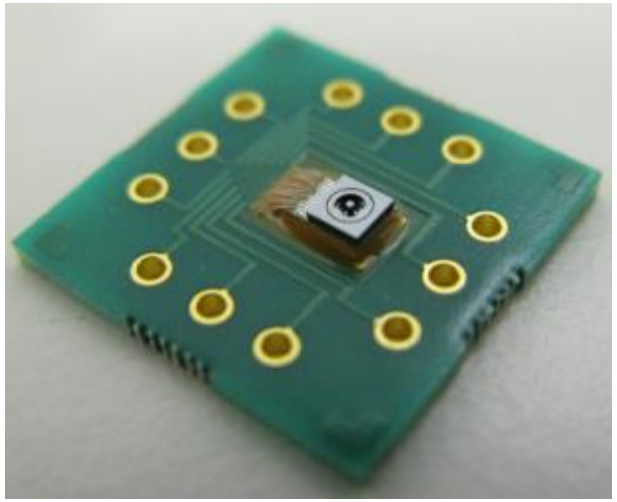
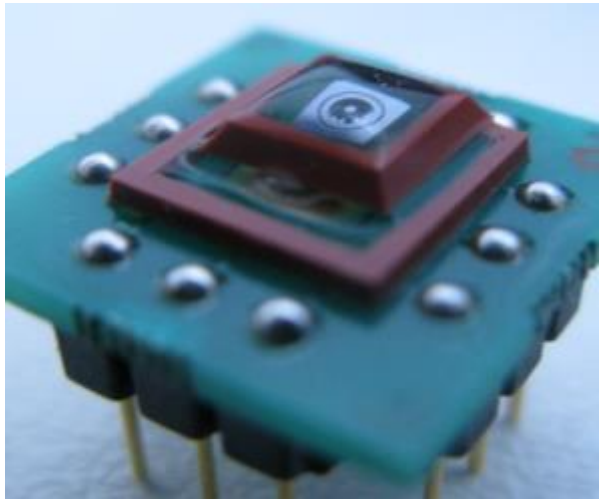
INCITE project - Intelligent Catheters in Advanced Systems for Interventions

3D force sensors for minimal invasive surgery applications

Force control or force feedback in Robinheart

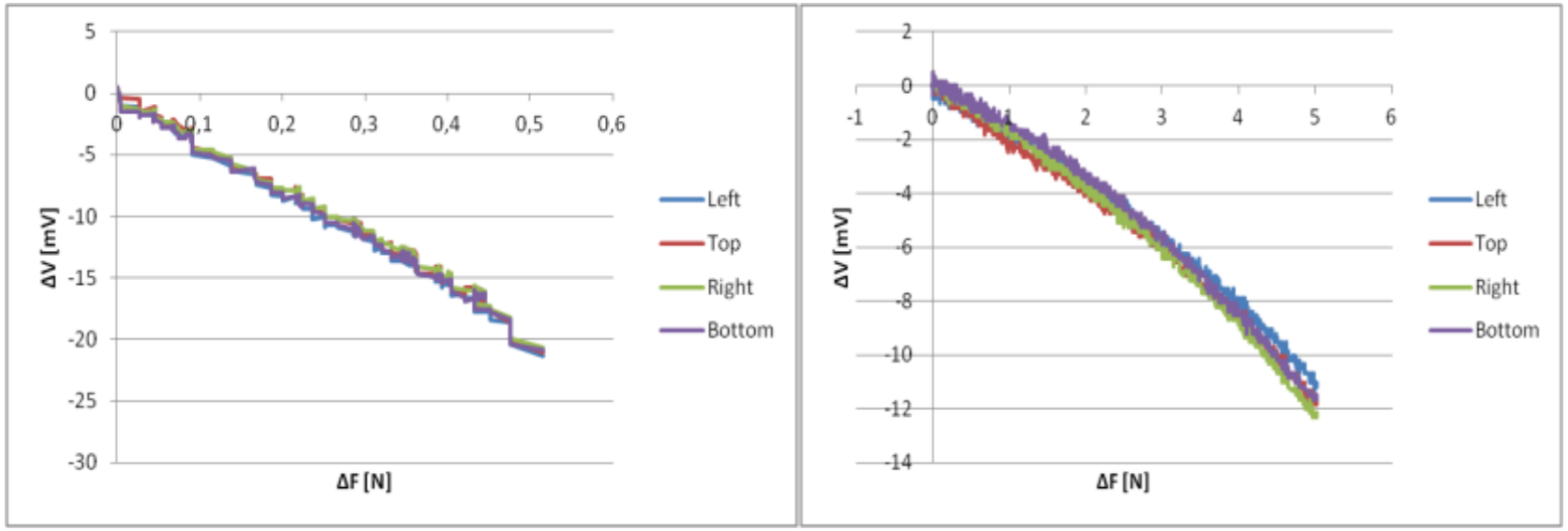
- Tactile sensing at the tip of the forceps (3D, 10g)
- Force measurement inside the forceps (1D, 10kg)
- Imaging camera control on the driving tool (3D, 100g)



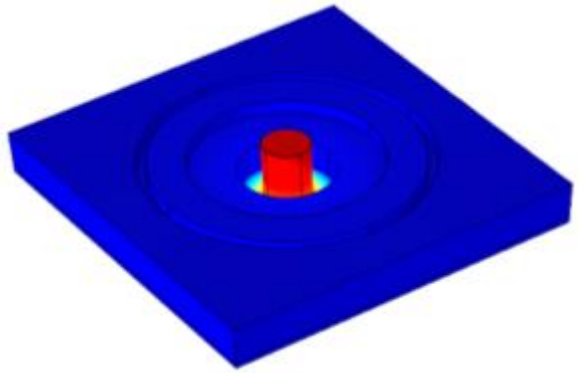
$2\times3mm^2$ full membrane-type force censor chip, bonded onto a glass wafer, coated by PDMS polymer

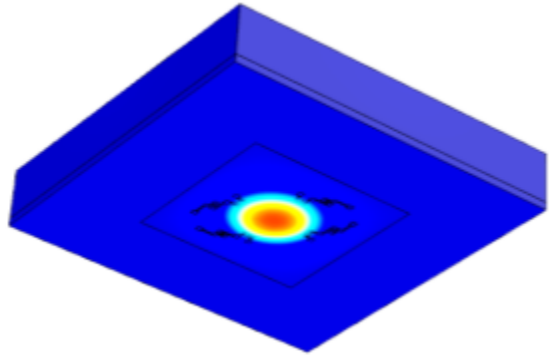
3D force calibratons

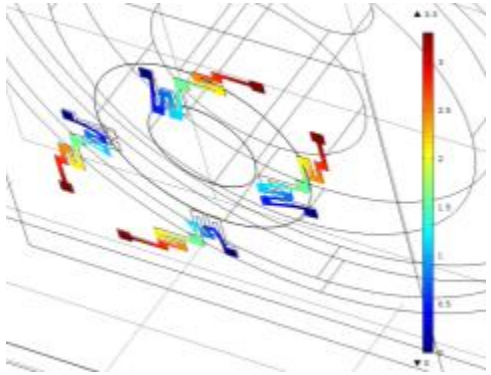


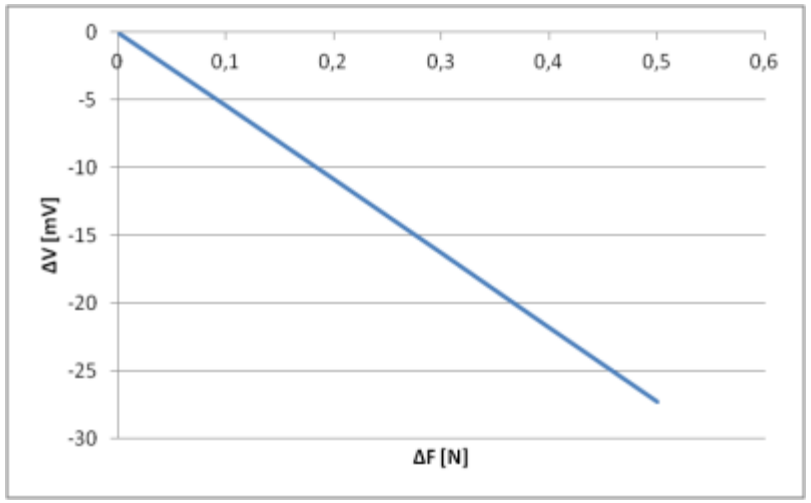
Out-of-balance voltages of the four half Wheatstone-bridges for perpendicular loads.
Bare chip (left), PDMS coated (right).

Modelling and FEM simulations









Demonstration of the multiphysical coupled FEM simulation of the piezoresistive 3D force sensors:

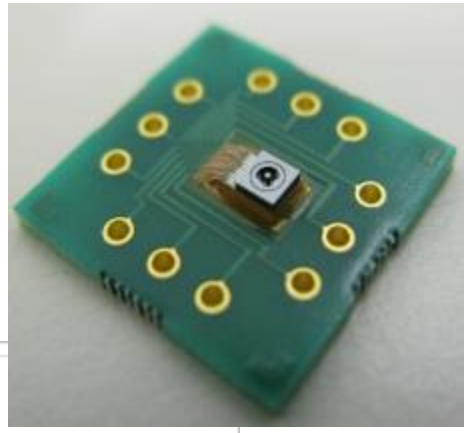
- membrane deformation (a),
- stress distribution along the integrated piezoresistors (b)
- the (perpendicular) force dependent sensor signal (c)

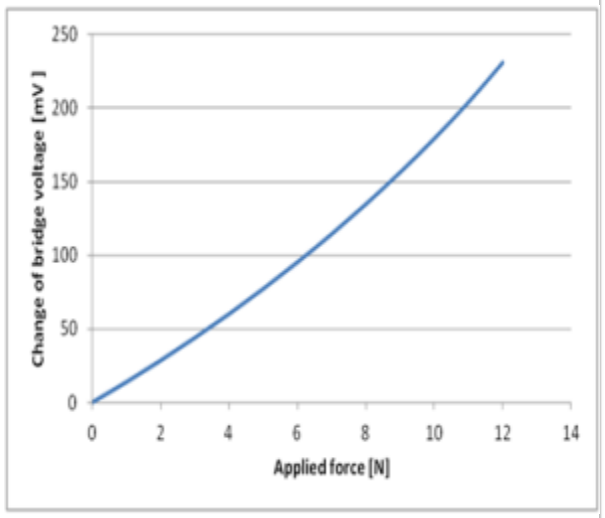
Sensitivity is tuned by the membrane thickness, in the mN range

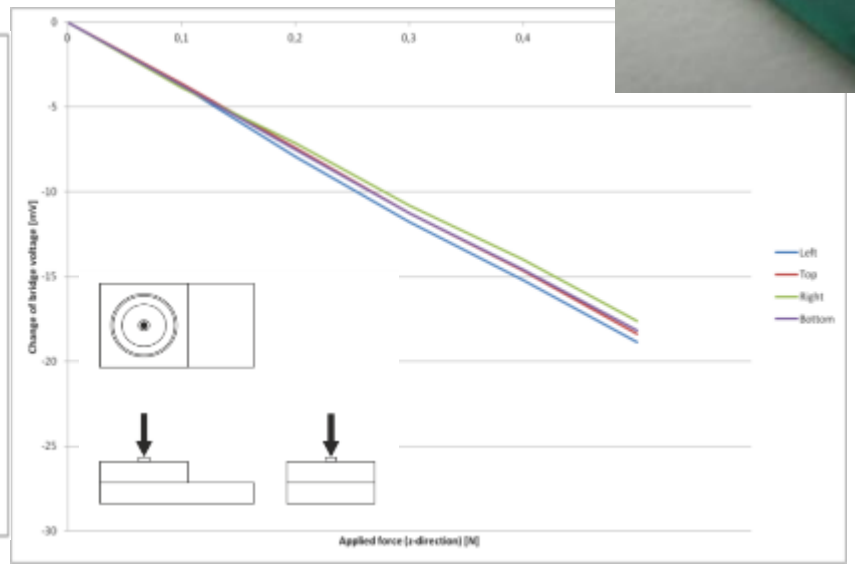
3D force sensors for minimal invasive surgery applications

Characterisation of the 3D MEMS force sensors

Testchip
chip size: 2×2mm^2
membrane diameter : 500µm,
membrane thickness: 50µm

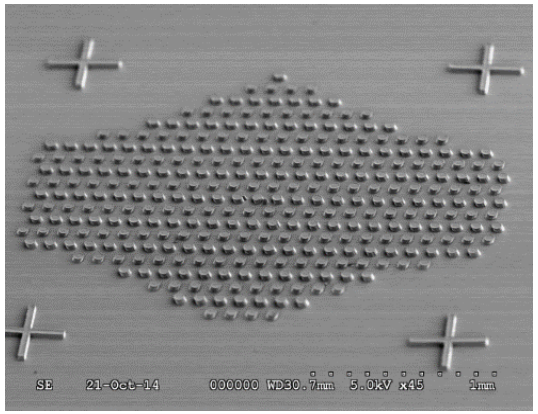


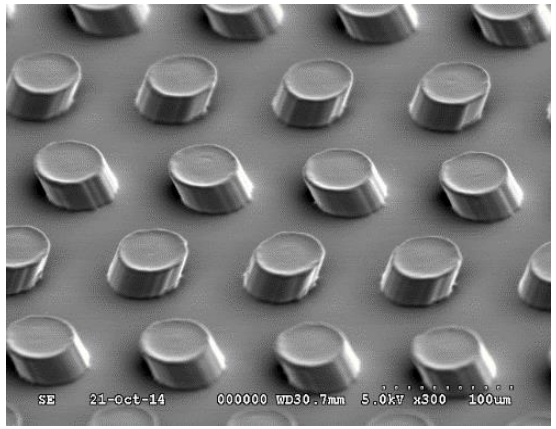




Microfluidic system for separation circulating tumor cells (CTC)

Microfluidic Cell Capture Devices (MCCDs)

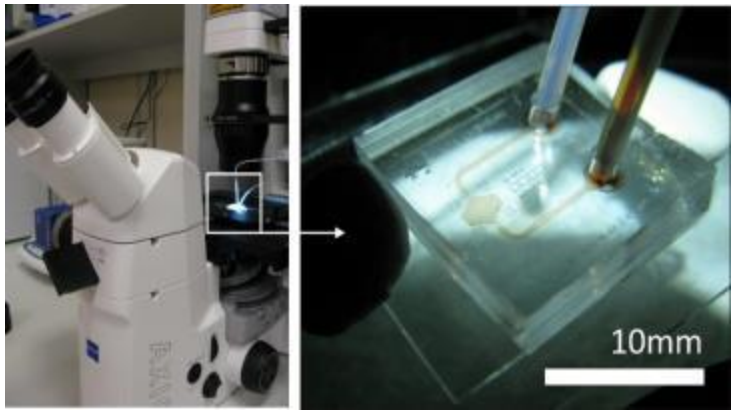


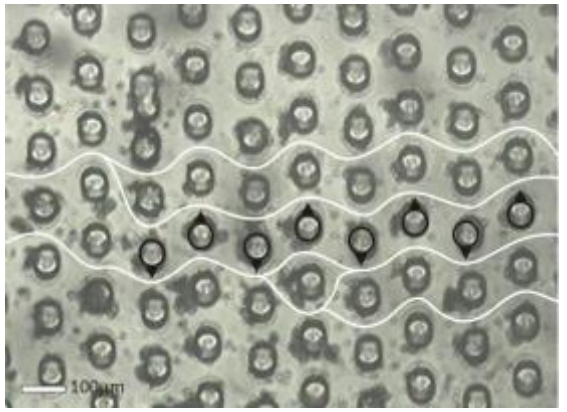


SEM images of doubly tilted micropillars fabricated from liquid PDMS by polymerization with focused proton beam on the top of a cross-linked PDMS layer.

Microfluidic system for separation circulating tumor cells (CTC)

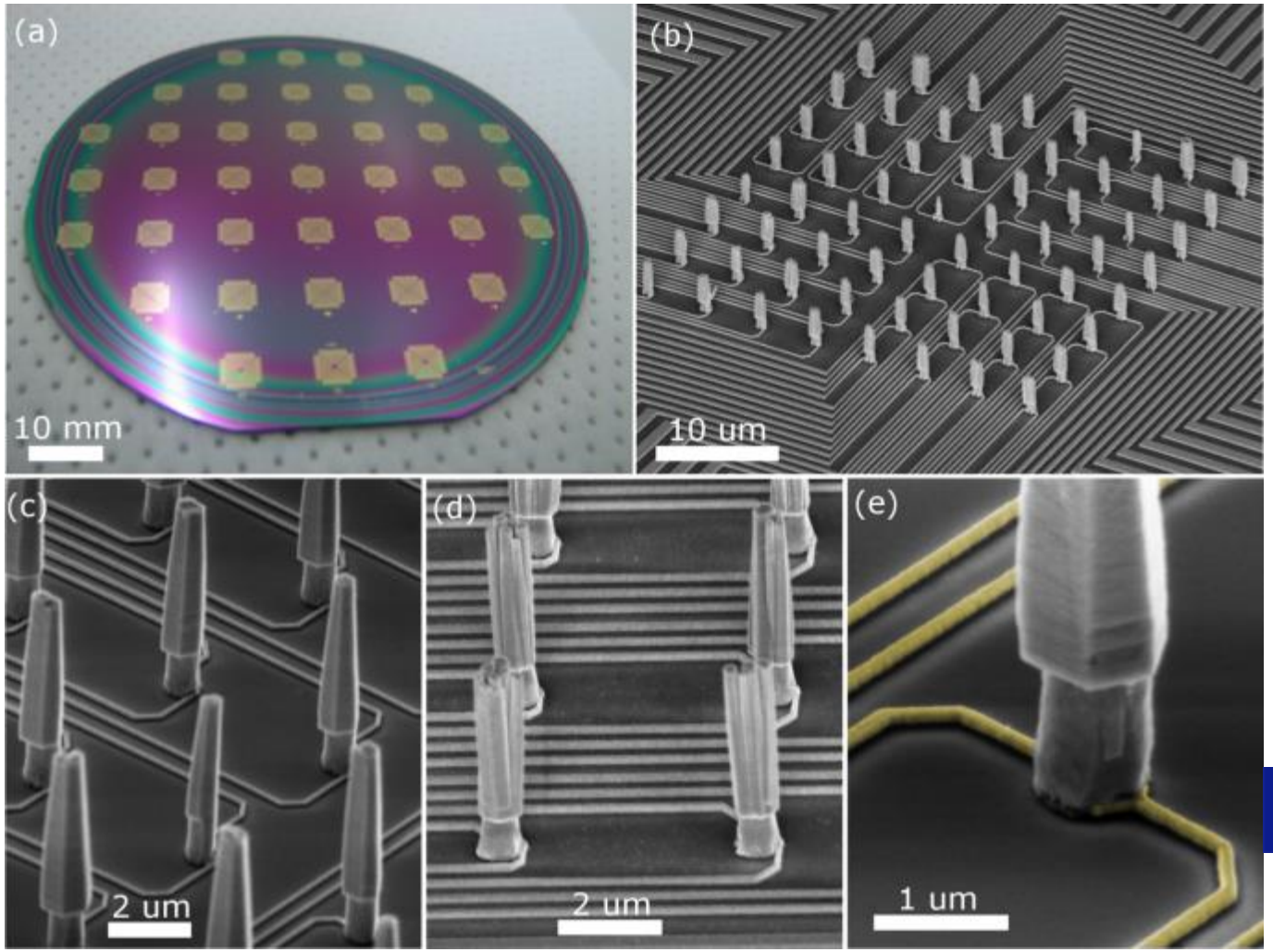
Microfluidic Cell Capture Devices (MCCDs)





The fabricated cell capturing device sealed by O_2 plasma enhanced bonding of the microfluidic and sorting subsysems was filled by biological test solution containing yeast cell culture.

Piezoelectric nanowires for tactile sensing

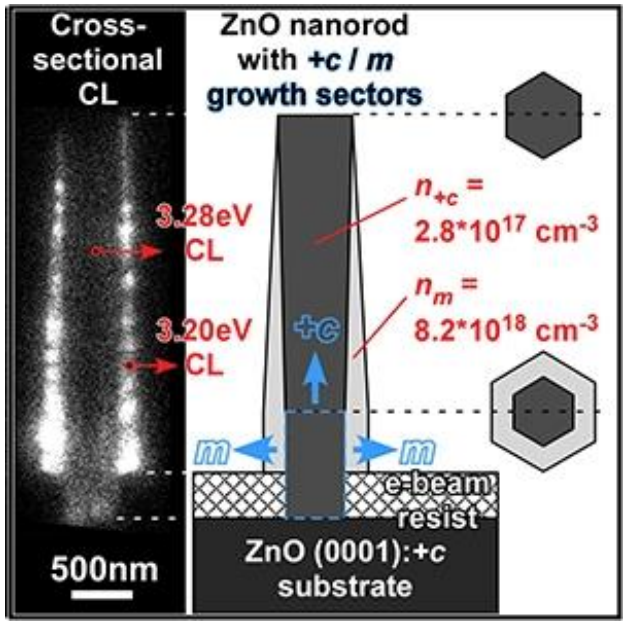


ZnO single crystalline nanowires grown by well controlled way, each nanowires are contacted, simultaneous measurement of piezoelectric respons of nanowires due to mechanical stress – fingerprint sensing

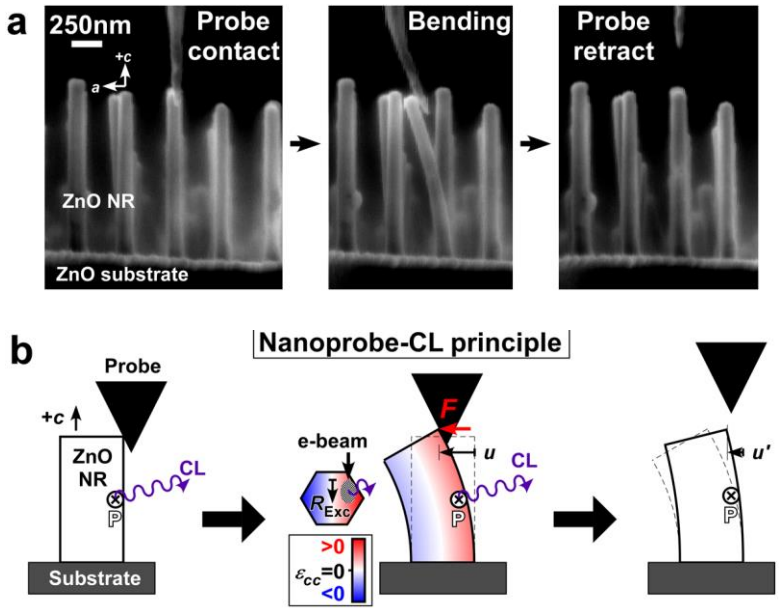
PiezoMAT project
www.piezomat.eu

Single crystalline ZnO nanowires grown by wet chemical method Characterization by Cathodluminescence spectroscopy (NIMS-MFA cooperation)

a) Inhomogeneities on FIB cross sections



b) In-situ CL during bending: - change of bandgap



Thank you for your attention

Materials, nanomaterials and technologies of the Applied Research Centre of SAS

Low cost TiAl-based precision cast turbocharger wheels for automotive industry

J. Lapin

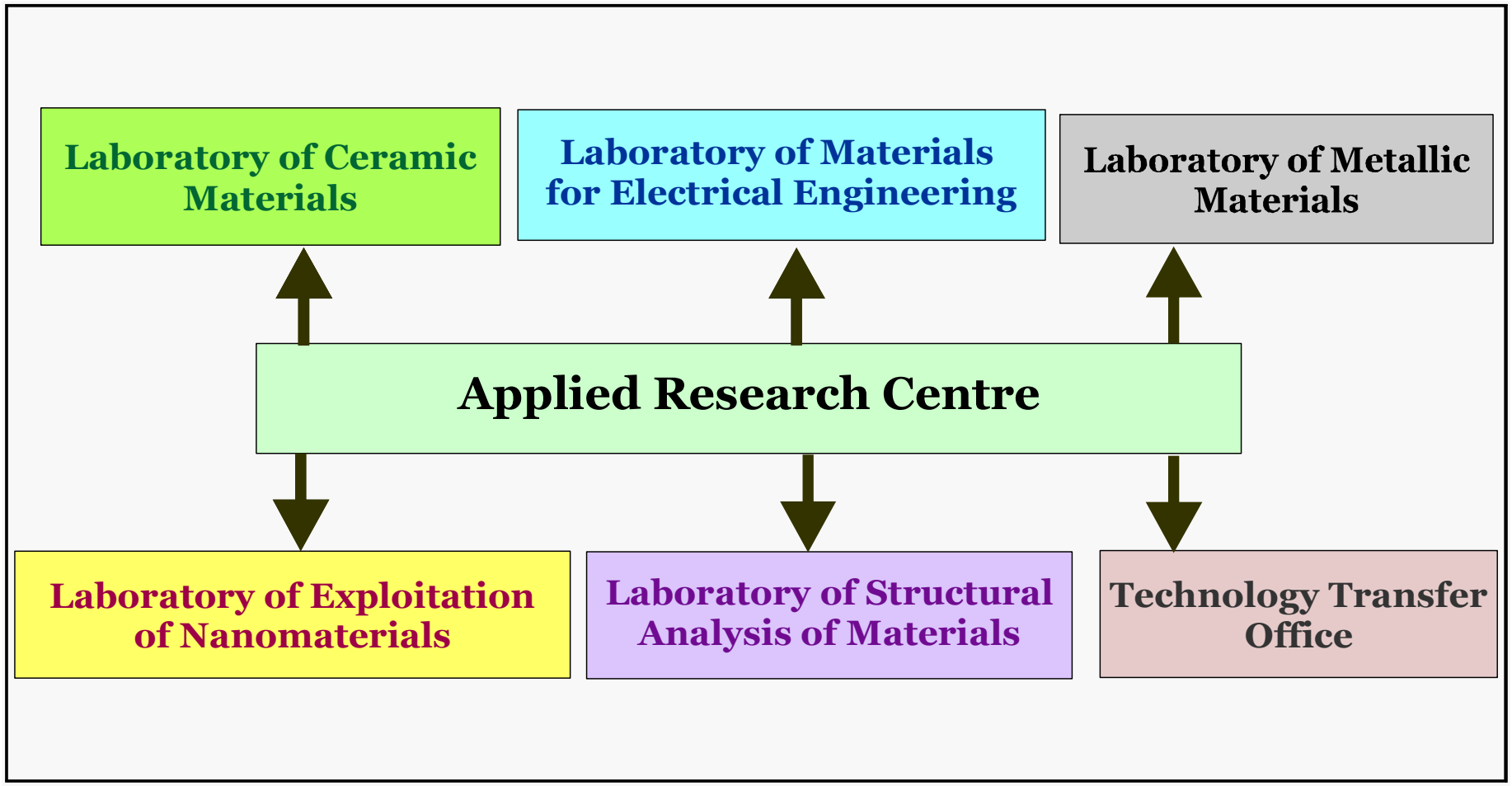
Director of the Applied Research Centre, Dubravska cesta 9, Bratislava, Slovak Republic

The Joint Visegrad 4 – Japan Seminar on Technology Transfer – Nanomaterials for Industrial Use, 16.6.2016, Tokyo, Japan

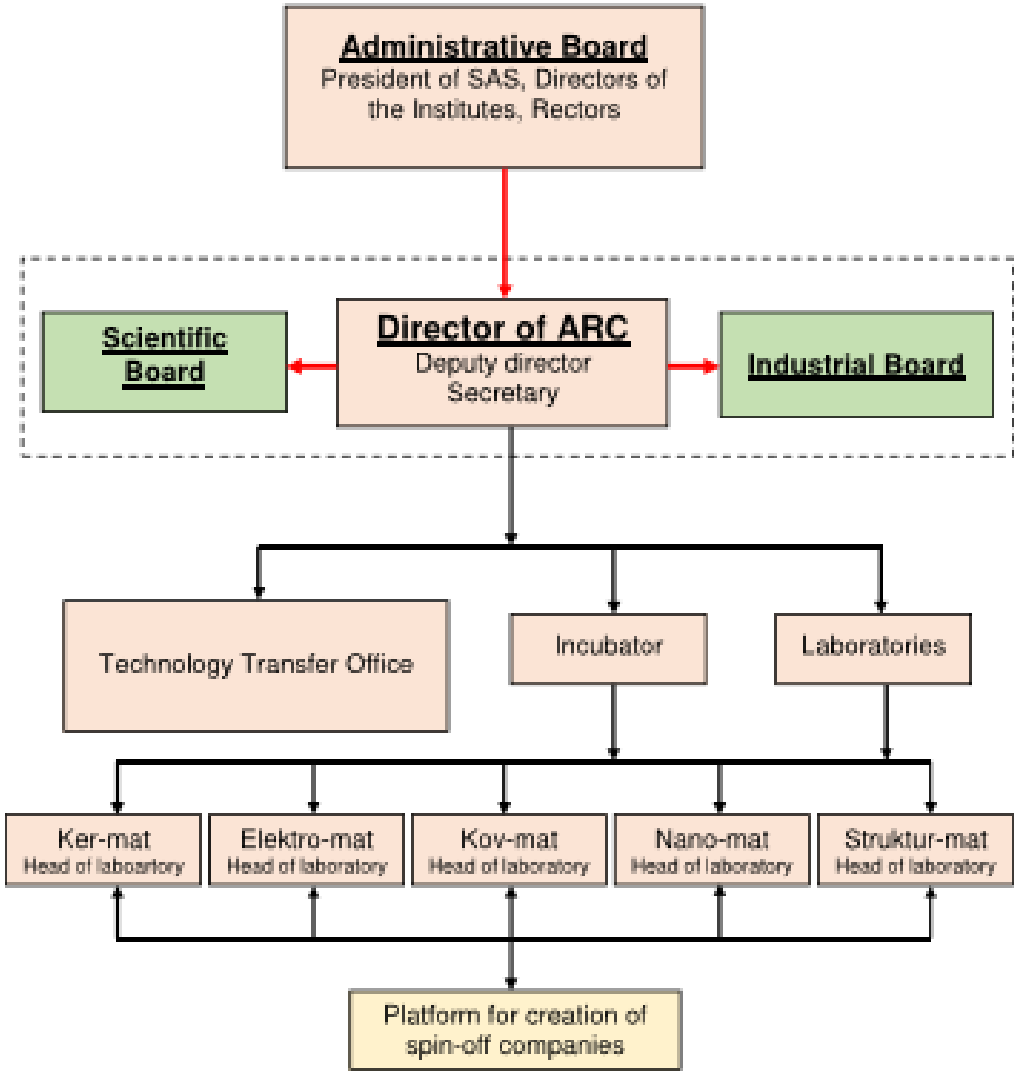
Centre of Applied Research

Applied Research Centre
October 2015

Schema of Applied Research Centre



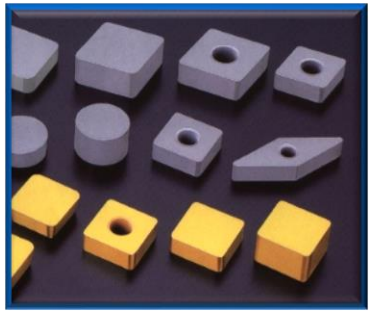
Management of Applied Research Centre



Laboratory of Ceramic Materials

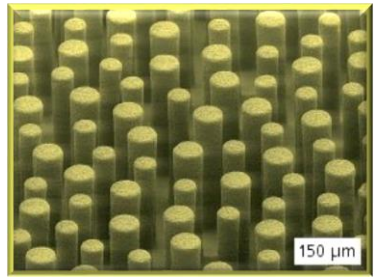
Prof. RNDr. Pavol Šajgalík, DrSc.
Ing. Jaroslav Sedláček, PhD.
doc. Ing. Miroslav Hnatko, PhD.

Cold isostatic press




Continous graphite furnace


Compaction press



Objectives

- Research and development of technologies for preparation of ceramic components
- Characterisation of properties of ceramic materials
- Preparation of demonstrators; balls and rollers for bearings, ceramic armours, plates for cutting tools, ceramic bio-implants

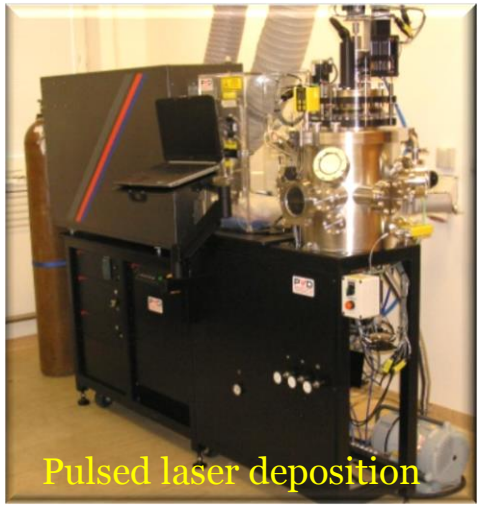
Granulating machine

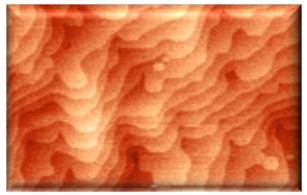
Laboratory of Materials for Electrical Engineering

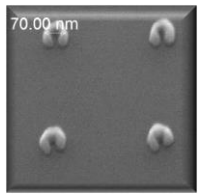
Ing. Karol Fröhlich, DrSc.
doc. Ing. F. Gömöry, DrSc.
Ing. J. Kuzmík, DrSc.
Ing. P. Kováč, DrSc.

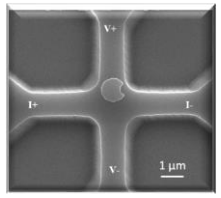

Atomic layer deposition

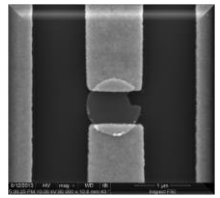
Metal organic chemical vapor deposition

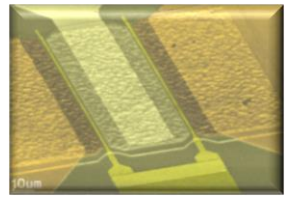

Pulsed laser deposition







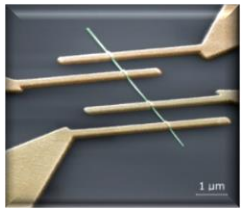


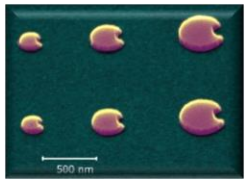


Objectives

- Research and development of advanced electronic components
- Preparation of thin films for transistors based on GaN
- Preparation of thin films for detectors based on GaAs
- Properties of superconducting wires in high magnetic fields

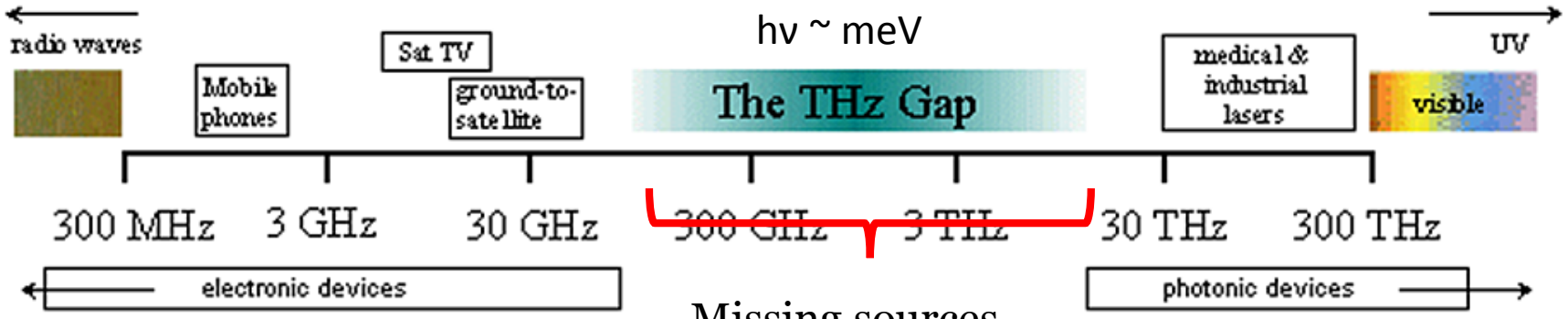

Clean room





Laboratory of Materials for Electrical Engineering

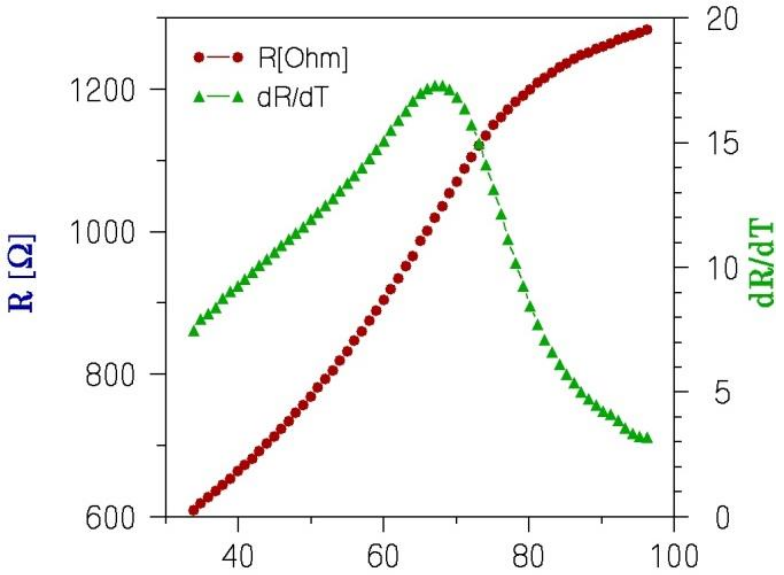
Detector for THz radiation



Missing sources and detectors

Aplications:

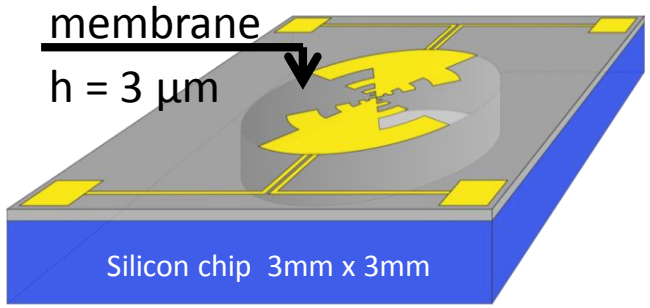
- Safety
- Medicine
- Telecommunications
- Enviroment

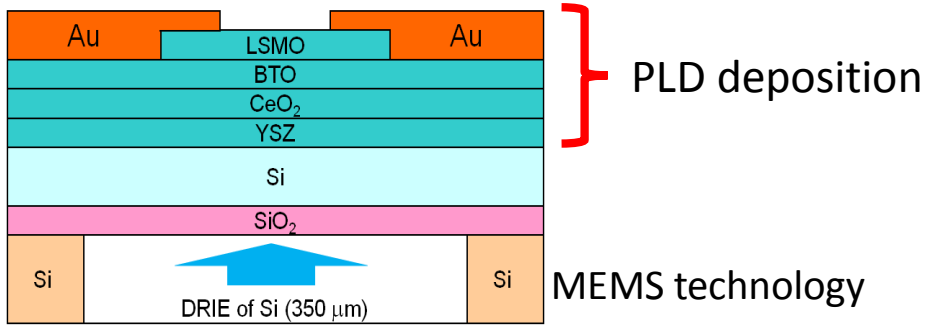


- IEE SAS designed and fabricated THz detector – microbolometer
- **The mikrobolometer** was successfully tested in PTB Berlin at **f = 1,4 THz**

Laboratory of Materials for Electrical Engineering

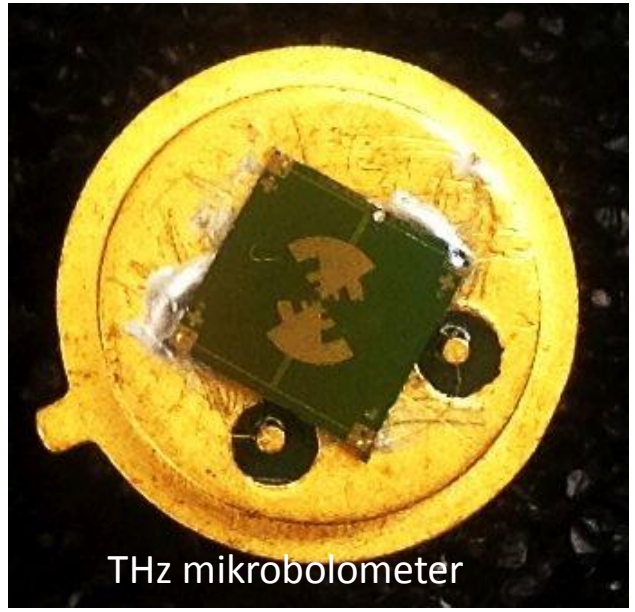
Detector for THz radiation

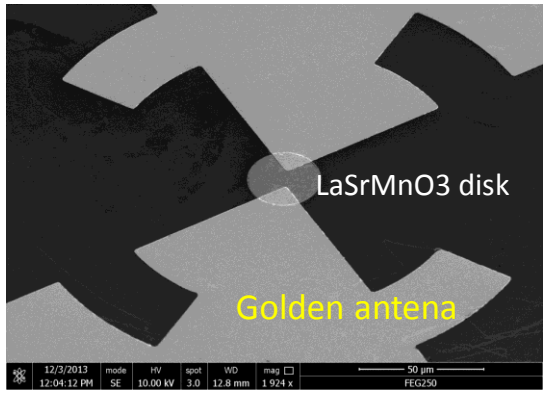




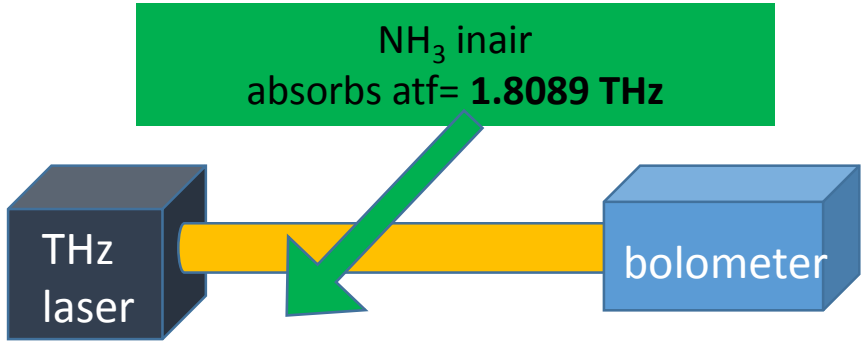
PLD deposition

MEMS technology





Possible application: NH_3 detector in air



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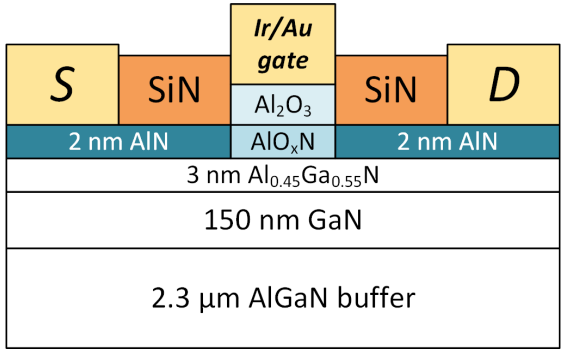
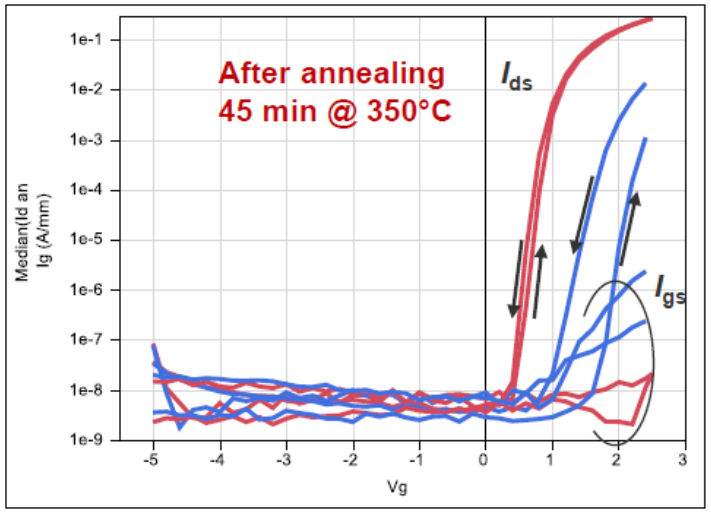
GaN-based high electron mobility transistors

- Based on original idea of “surface donors” manipulation at oxide/III-N interface [Tapajna et al. APL 100 (2012) 113509]
- Normally-off AlGaN/GaN HEMTs with inherent metal-oxide interface

  [Gregušová et al. APL 104 (2014) 013506]
- Technology transfer to FBH – 4” GaN-on-Si wafers within EU FP7 project HipoSwitch





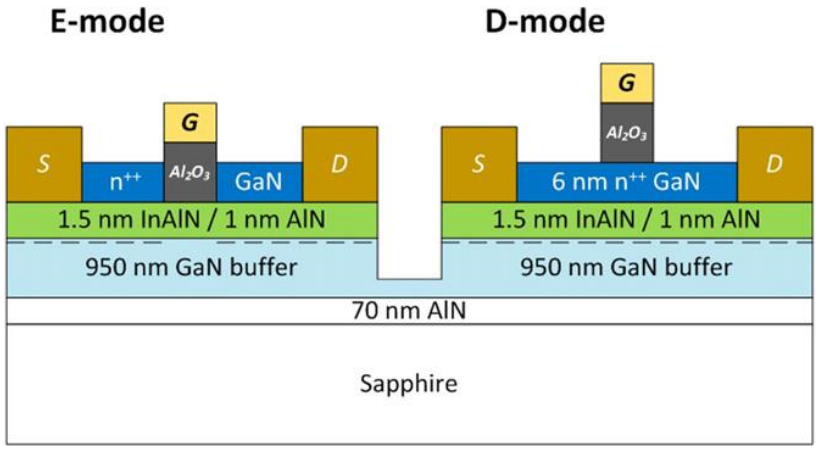
V_{ds} = 10 V

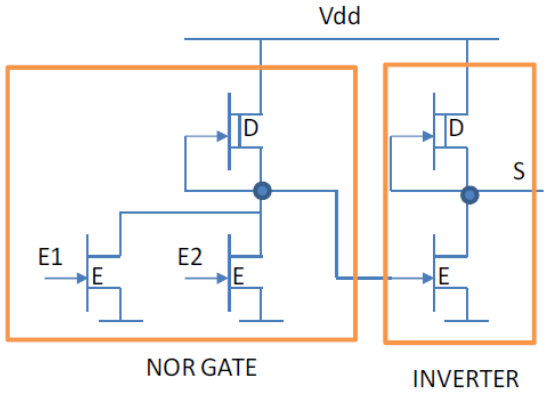
Laboratory of Materials for Electrical Engineering

GaN-based high electron mobility transistors

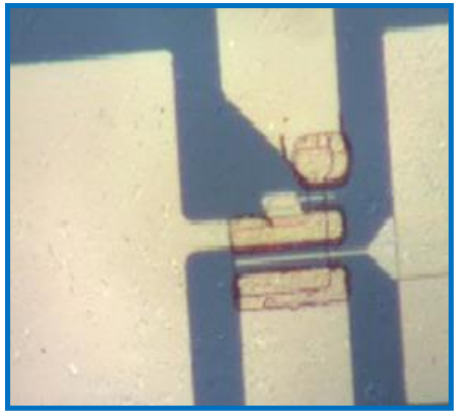
Monolithic integration of Enhancement & Depletion- mode

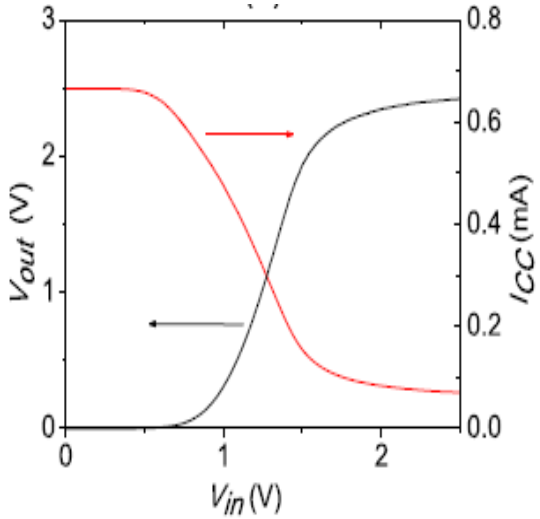
- Development of unique technology for enhancement and depletion (normally-ON & OFF) InAlN/GaN HEMTs using MOS gate structure
  Blaho et al. PSS(a) 212 (2015)
- Monolithic integration of both types of transistors Blaho et al. SST 31 (2016)
- Demonstration of fundamental logic circuits (Inverter, NAND, NOR) using Charge Coupled Logic





IC for mixed anologue/digital signal





Laboratory of Metallic Materials

Ing. J. Lapin, DrSc.
doc. Ing. V. Hrnčiar, CSc.
Ing. M. Balog, PhD.

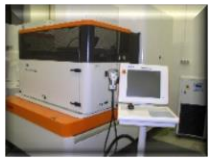

Leco

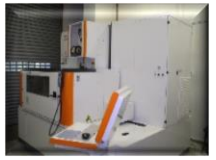
Forging press


OES spectrometer


Extrusion press

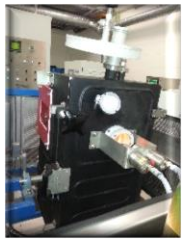

Resistance furnace

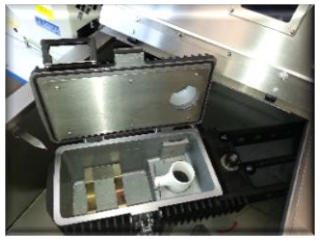


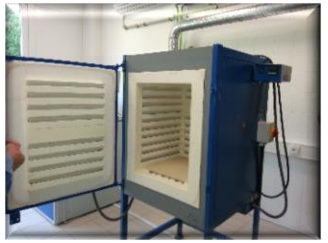



Till casting


Centrifugal casting







Objectives

- Research and development of precise casting technology for TiAl based alloys
- Research and development of powder metallurgy technology for composite materials
- Preparation of demonstrators from titanium alloys, high temperature alloys, intermetallic alloys and aluminium alloys
- Characterisation of properties of components

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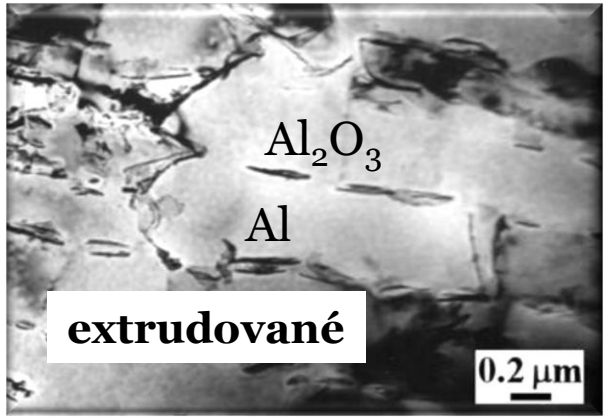
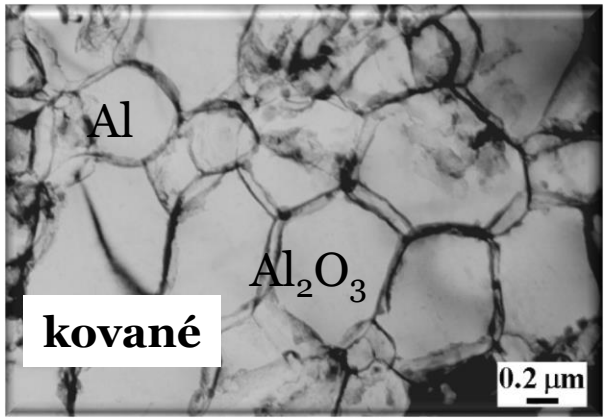
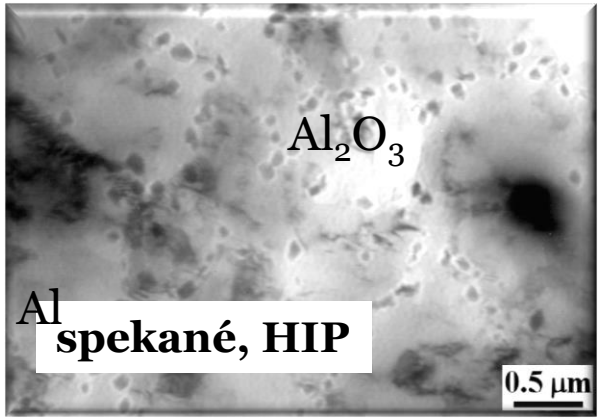
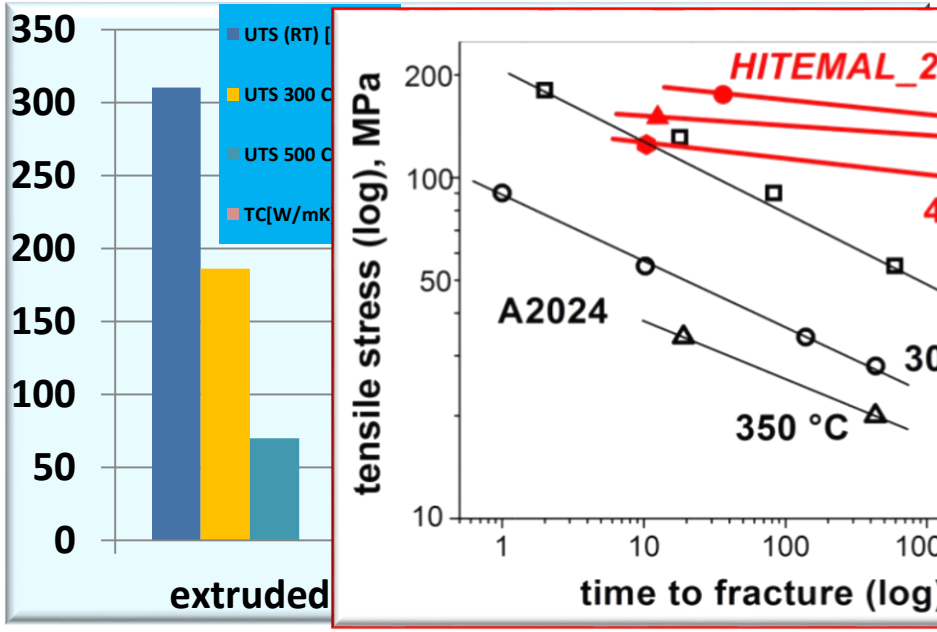




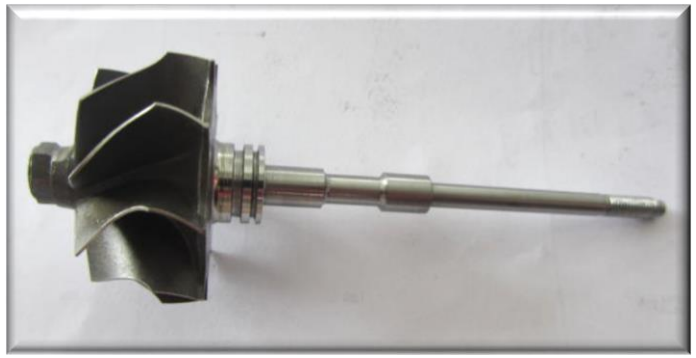


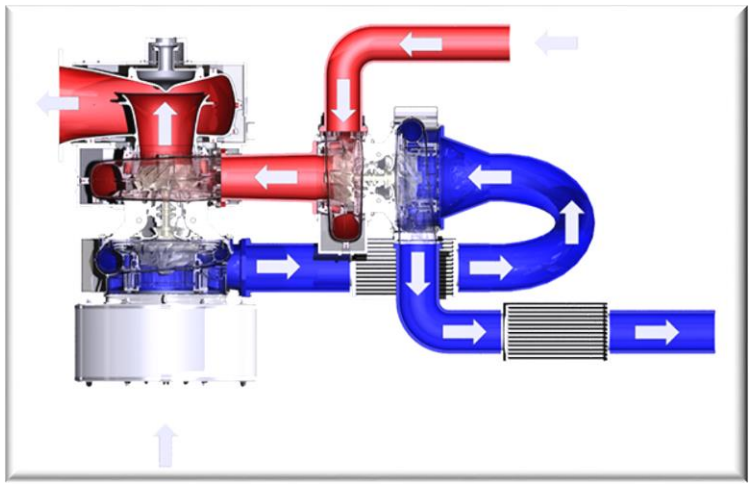


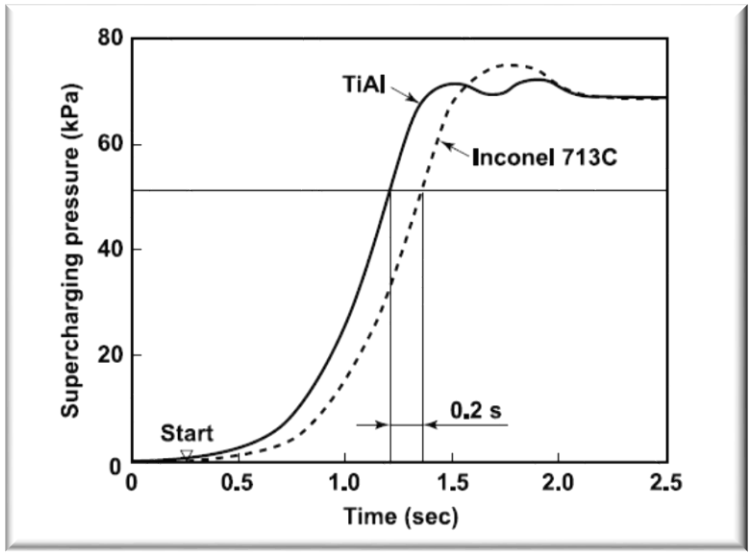
HITEMAL high temperature aluminium stabilised by nano Al_2O_3

Laboratory of Metallic Materials

Development of light weight high-temperature structural materials and precise casting technology for components of automotive turbochargers







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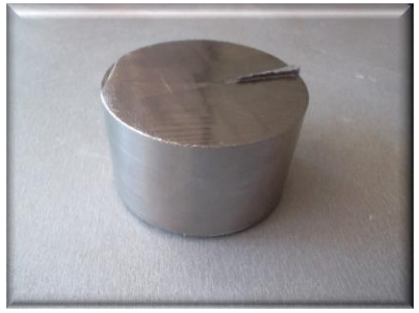

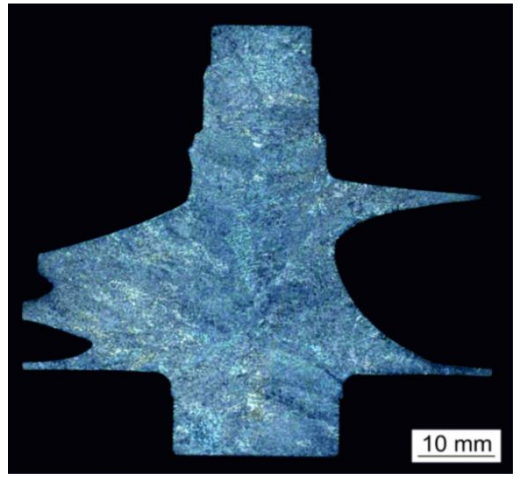

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry

Pure Y_2O_3 crucible for induction melting.

Al_2O_3 based crucible with inner Y_2O_3 layer for induction melting.

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Low cost TiAl-based precision cast turbocharger wheels for automotive industry

Al2O3 based mould with inner Y2O3 layer.

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Low cost TiAl-based precision cast turbocharger wheels for automotive industry

Ceramic mould after casting.

Rough casting removed from the mould.

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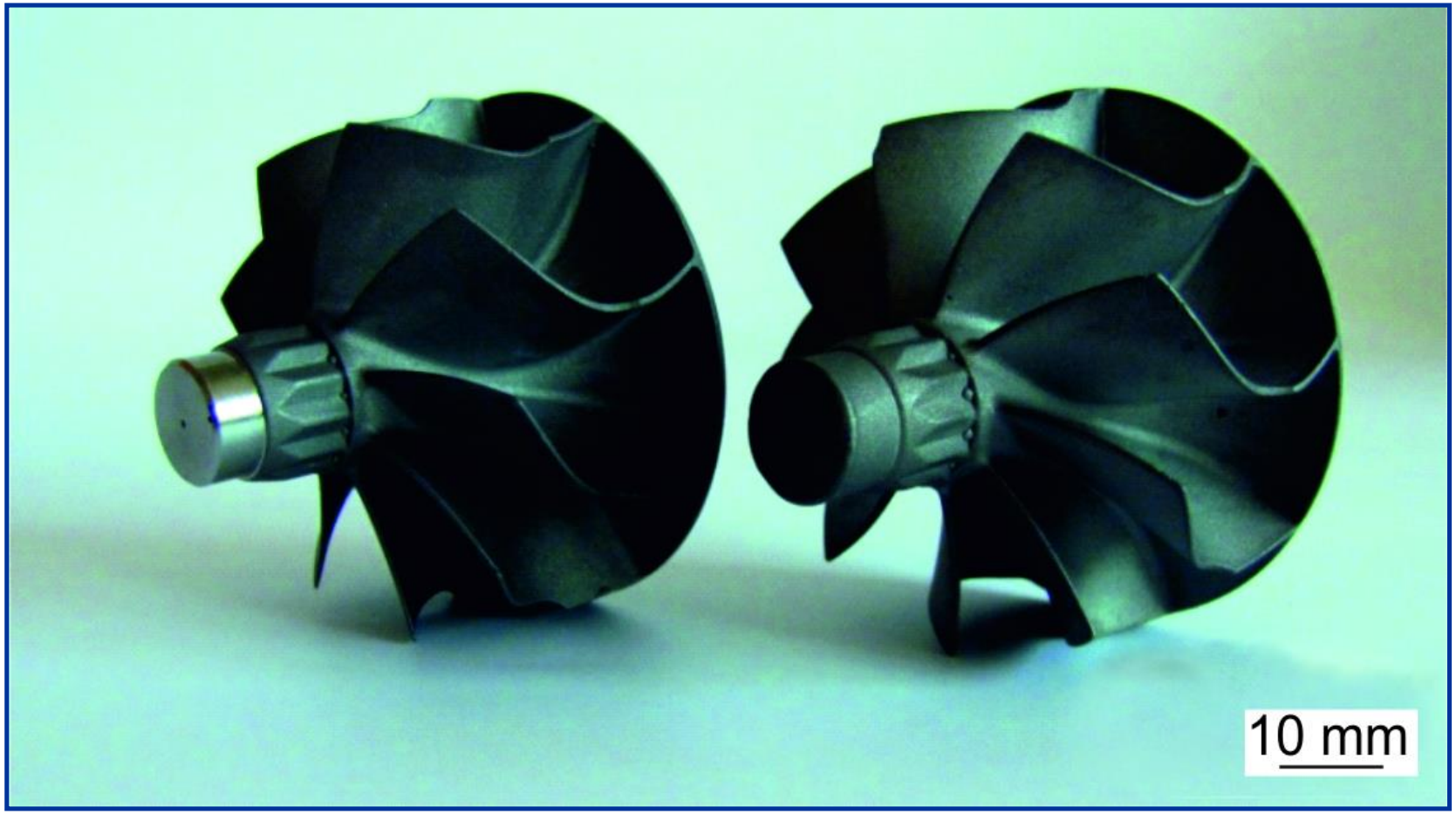
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Cast turbocharger wheels with removed feeding heads.

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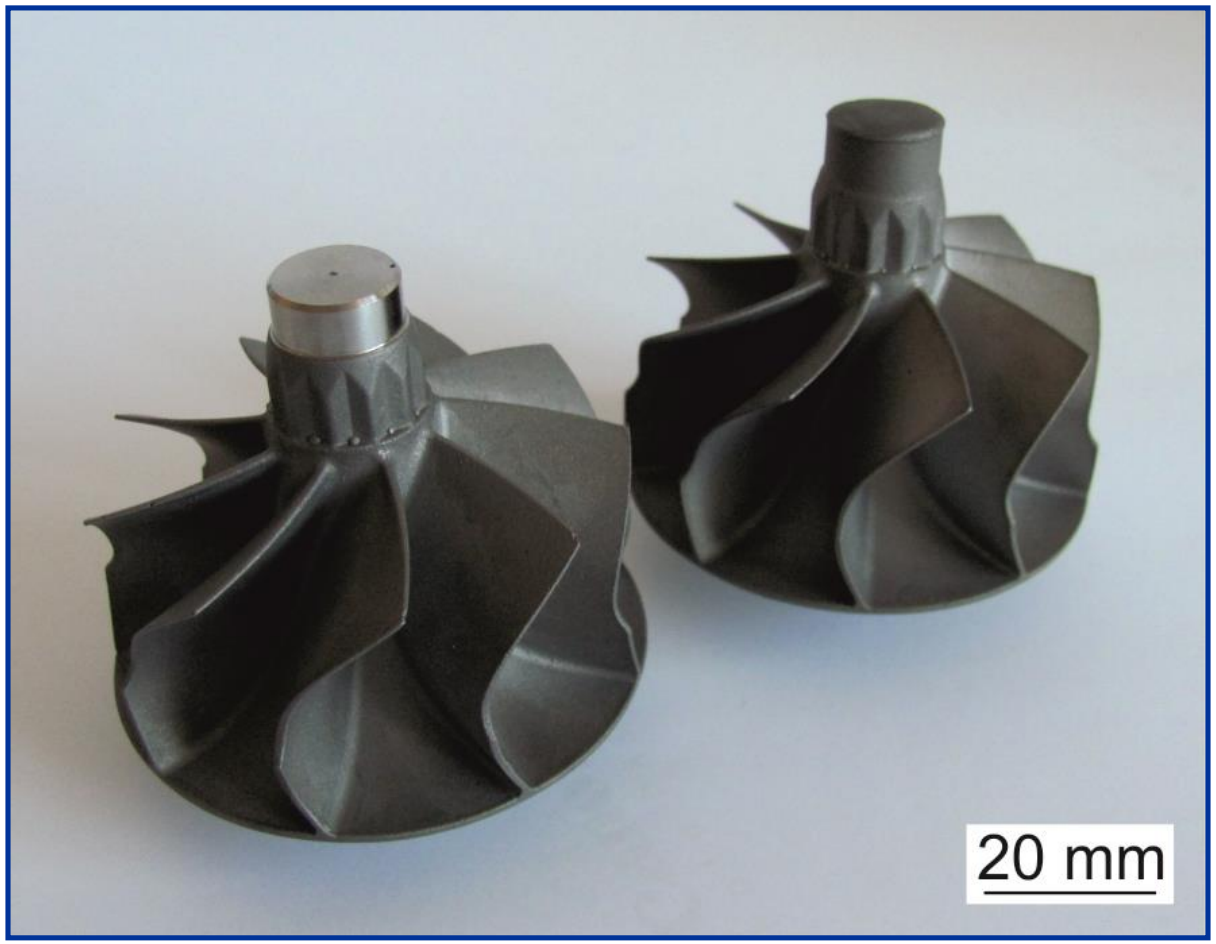
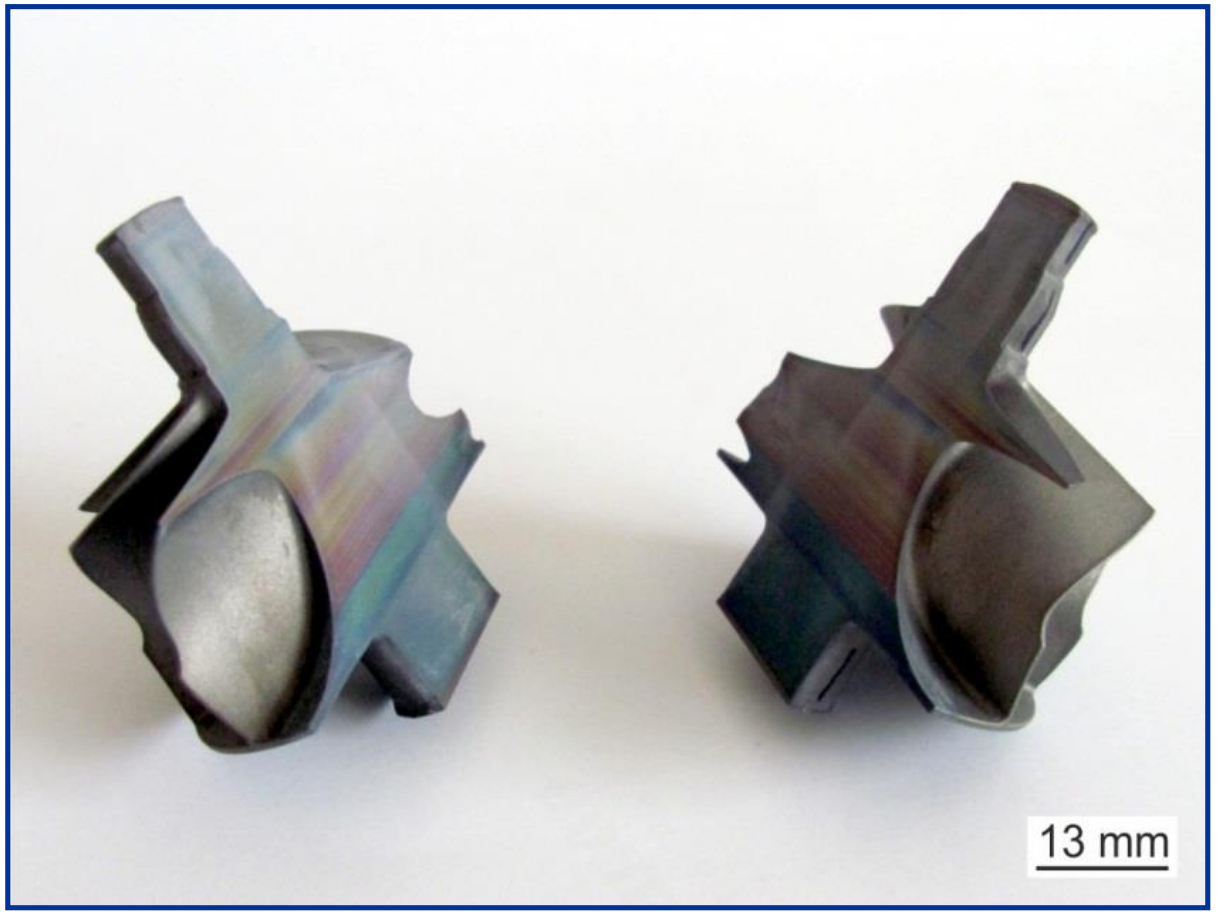
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Cast turbocharger wheels with removed feeding heads.

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Longitudinal section of turbocharger wheel.

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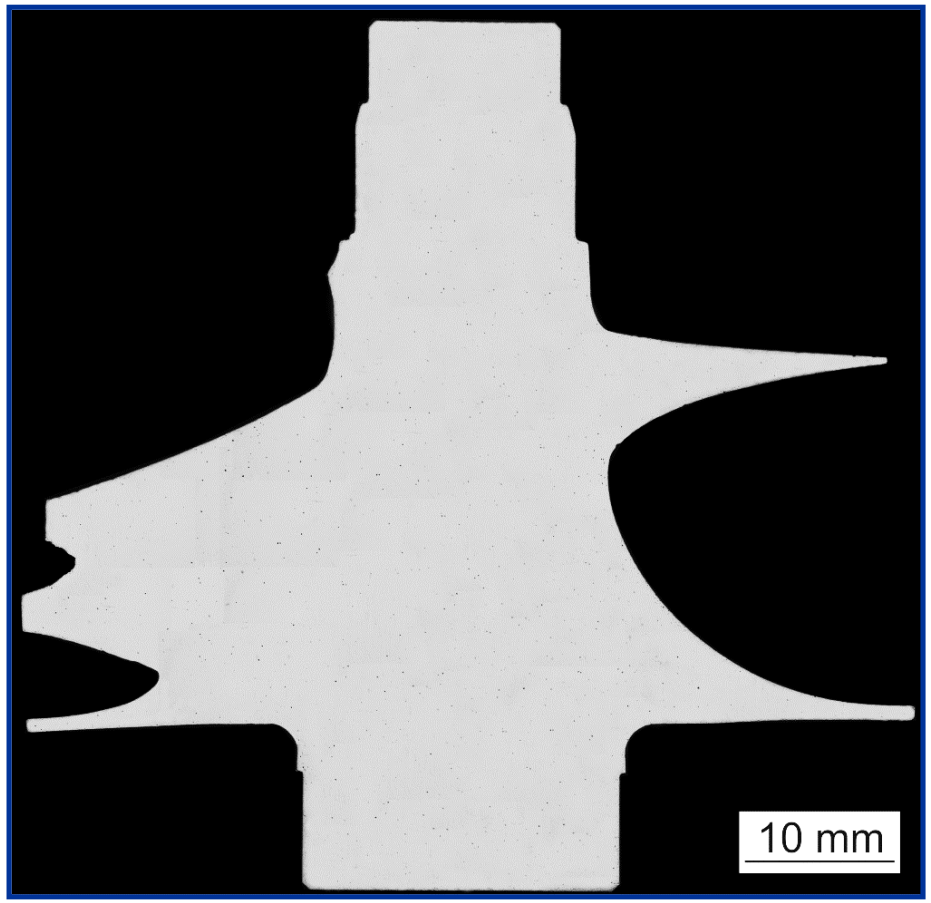
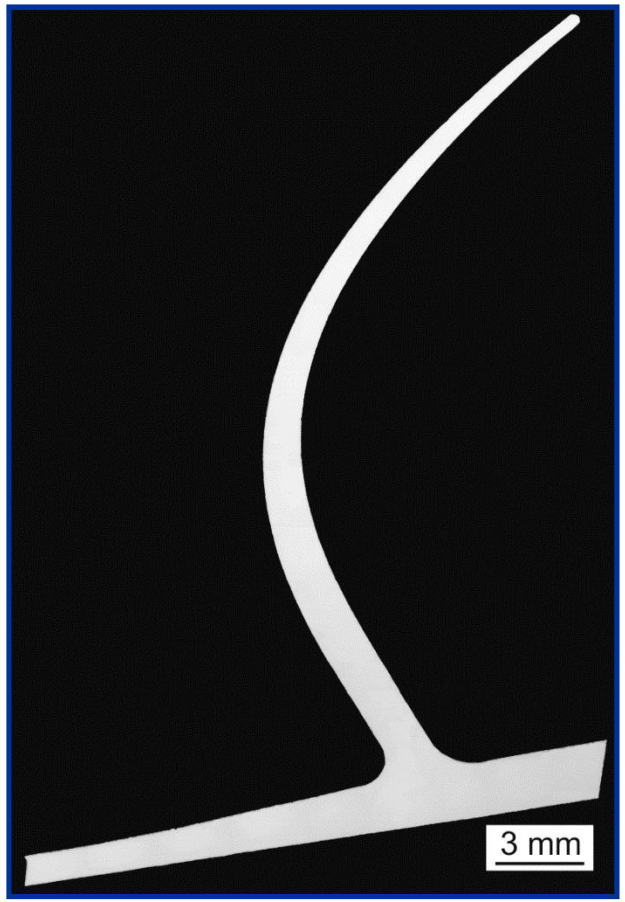
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Polished longitudinal section of turbocharger wheel without visible defects.



Polished section of turbocharger wheel blade.

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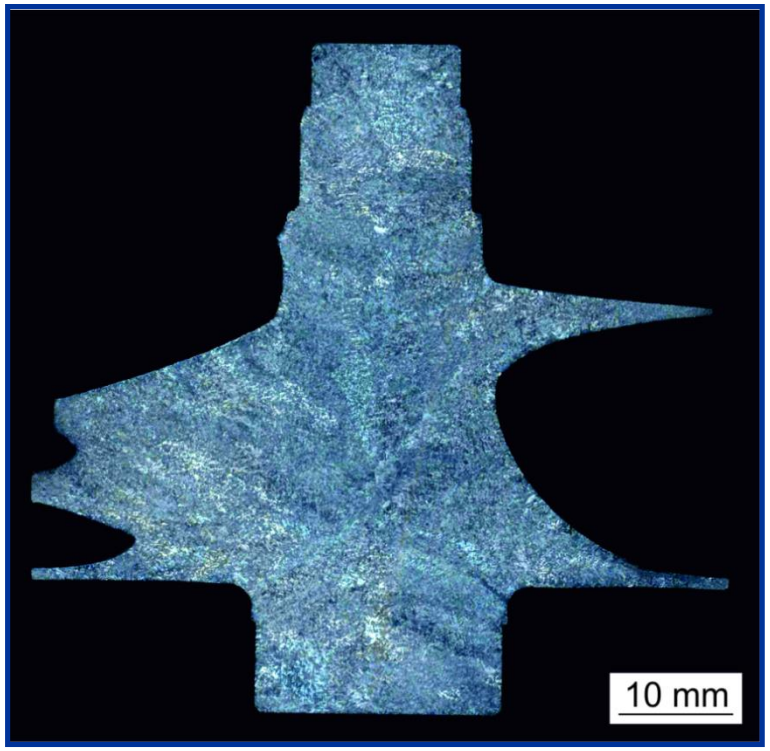
Low cost TiAl-based precision cast turbocharger wheels for automotive industry

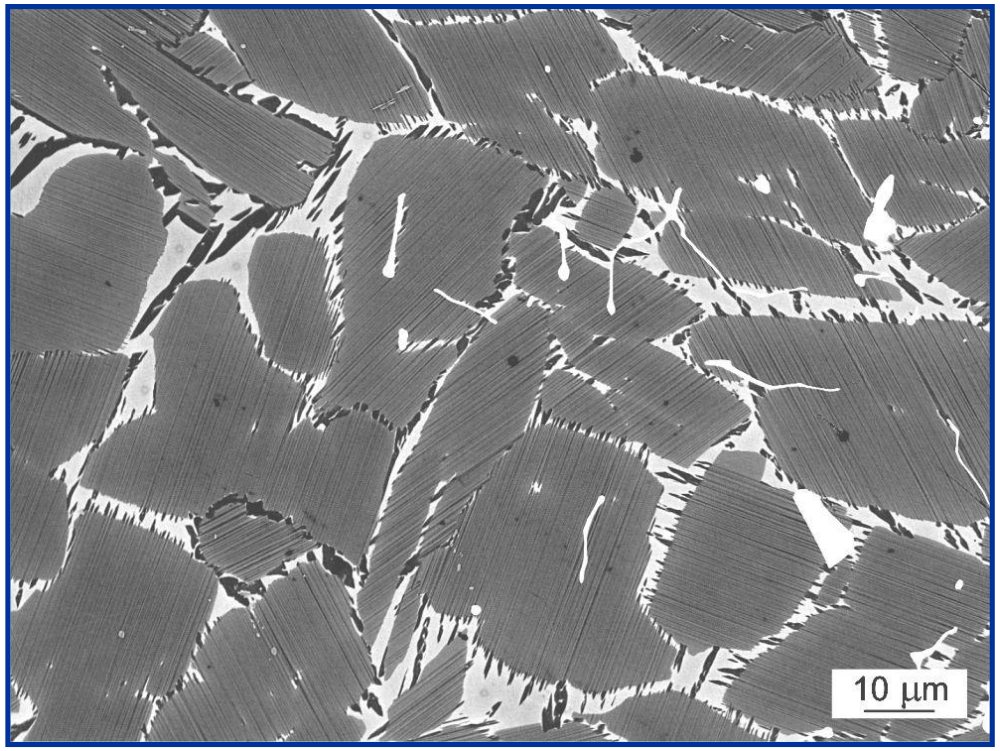
Casting	Crucible	Holding time (s)	Porosity (vol.%)	Y_2O_3 (vol.%)	Oxygen (wtppm)
T6 - feeding head	Y2O3	240	3.9	0.8	2130
T7 - feading head	Y2O3	480	-	0.7	3080
T8 - feading head	Y2O3	300	-	0.5	1990
T9 - feading head	Y2O3	420	4.2	0.6	1850
T10 - feading head	Al2O3+Y2O3	180	2.9	0.7	1570
T11 - feading head	Al2O3+Y2O3	120	-	0.8	
T12 - feading head	Al2O3+Y2O3	120	1.6	0.7	1274
T12 – blade	Al2O3+Y2O3	120	0.1	0.4	-
T12 – center of wheel	Al2O3+Y2O3	120	0.7	0.5	1274
T13 -feading head	Y2O3	480	2.5	0.6	1940
T13 - blade	Y2O3	480	0.5	0.5	-
T13 – center of wheel	Y2O3	480	1.2	0.6	1940

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Macrostructure on longitudinal section of cast turbocharger wheel.



The typical microstructure of cast turbocharger wheel.

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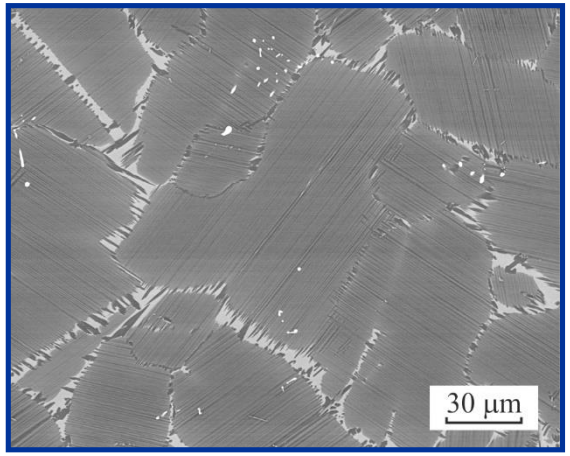
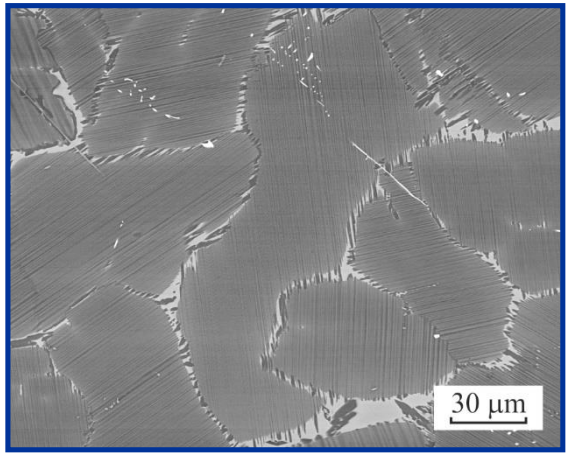
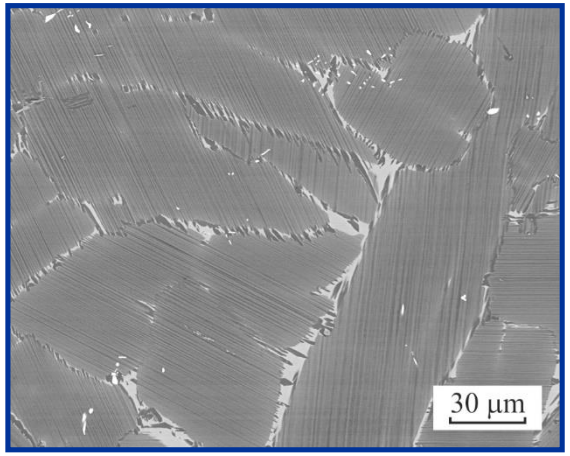
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



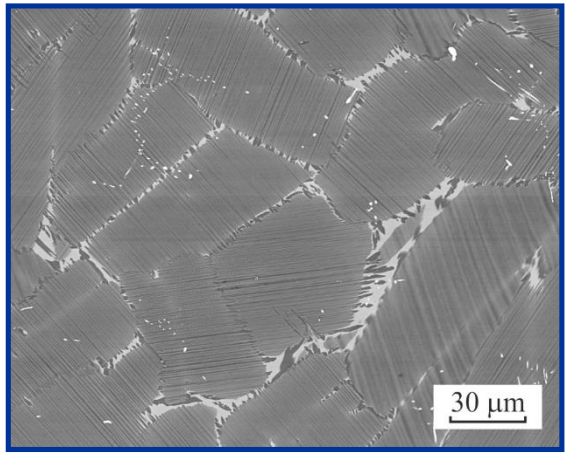
4 mm



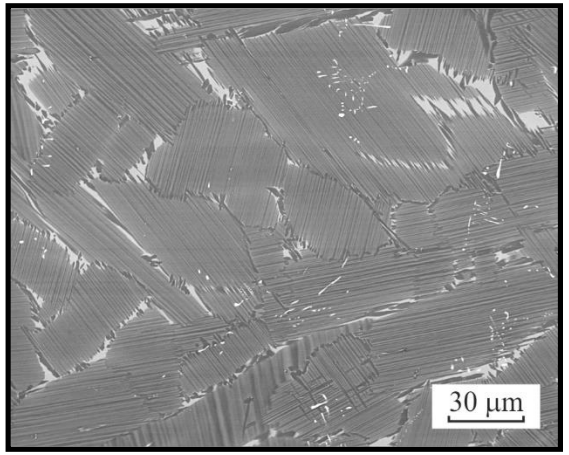
8 mm



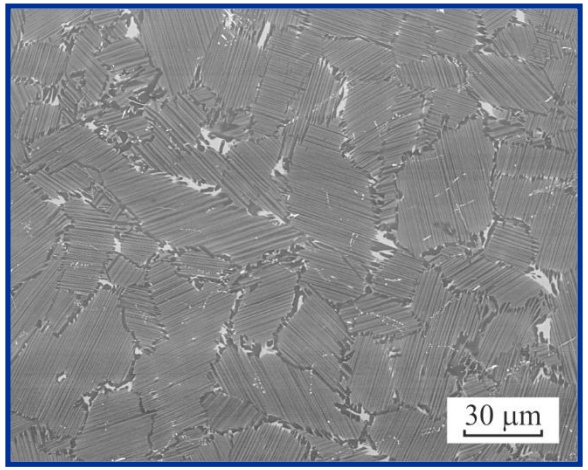
12 mm



16 mm



20 mm



24 mm

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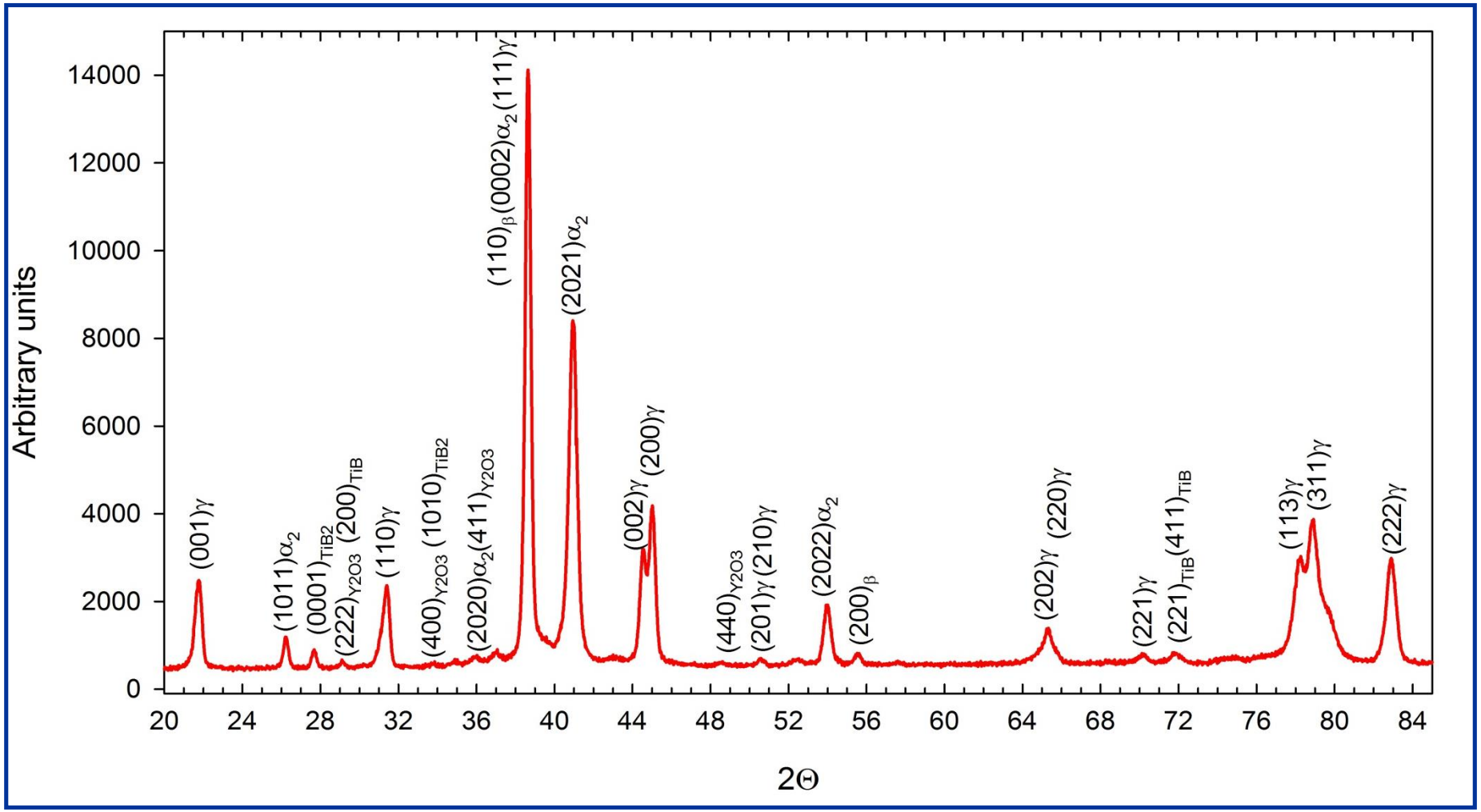
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



XRD analysis of cast turbocharger wheel showing coexisting phases.

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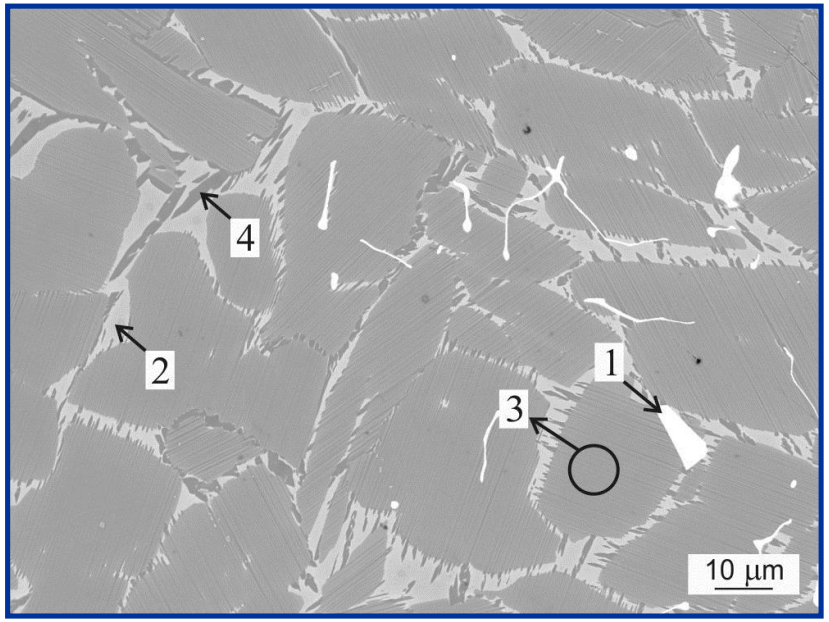
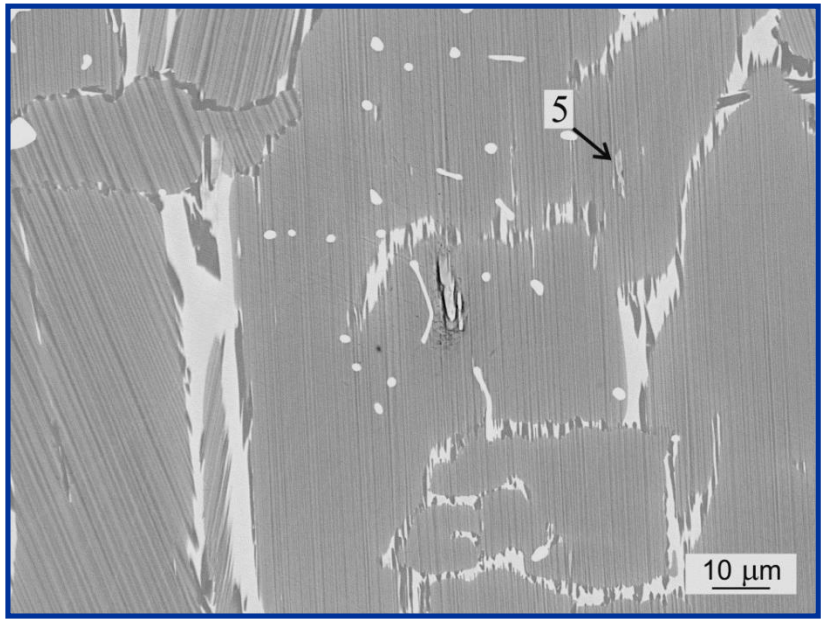
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



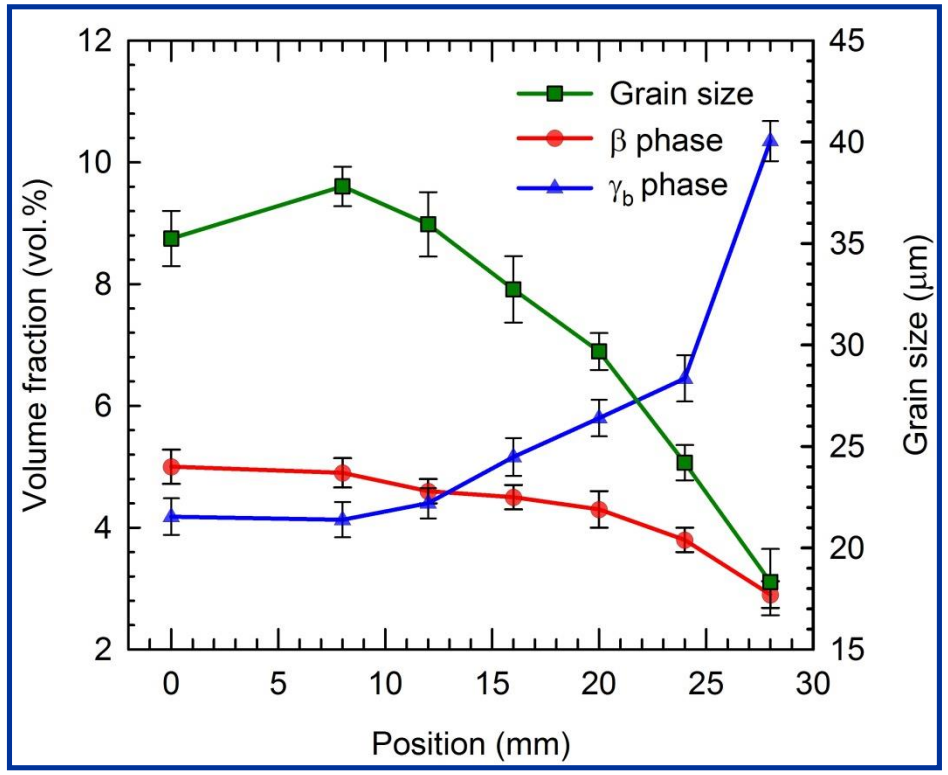


Chemical composition of coexisting phases measured by EDS

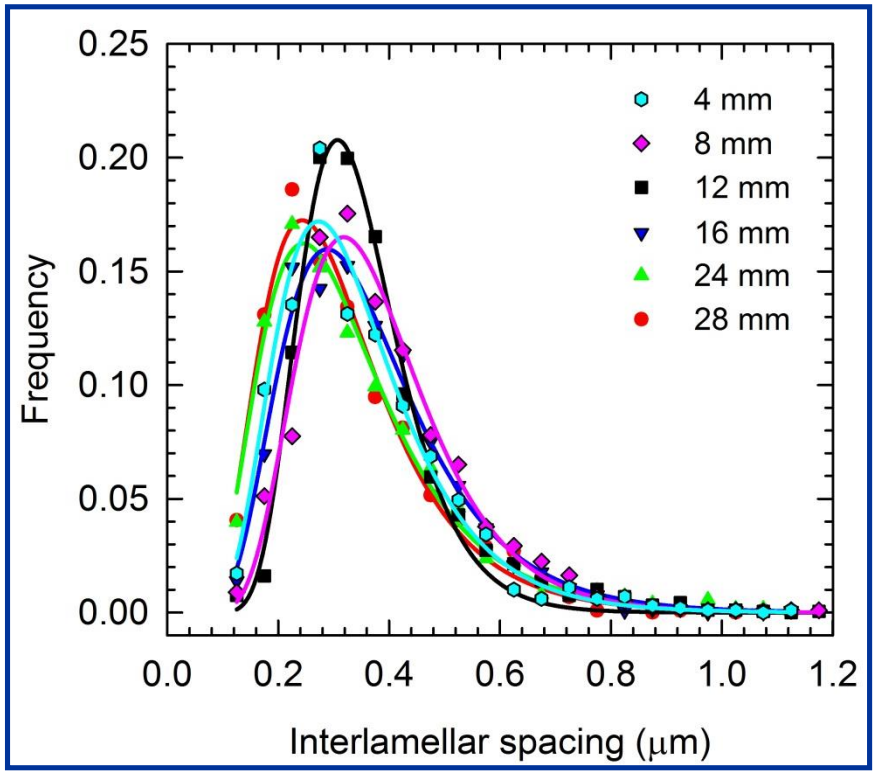
	Ti (at.%)	Al (at.%)	Nb (at.%)	Mo (at.%)	Y (at.%)	O (at.%)	B (at.%)
1	1.2 ± 0.4	-	-	-	45.2 ±0.6	53.6 ± 0.2	-
2	56.3 ± 0.5	35.8 ± 0.4	5.6 ± 0.4	2.3 ± 0.7	-	-	-
3	52.5 ± 0.1	42.6 ± 0.1	4.1 ± 0.3	0.8 ± 0.1	-	-	-
4	48.7 ± 0.7	47.1 ± 0.2	4.2 ± 0.5	-	-	-	-
5	27.4 ± 0.4	9.6 ± 0.4	3.4 ± 0.2	-	-	-	59.6 ± 0.5

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Evolution of grain size, volume fraction of β phase and volume fraction γ_b phase along the grain boundaries with the position in as-cast turbocharger wheel.



Log-normal distribution curves for α2-α2 interlamellar spacing measured in defined position of as-cast turbocharger wheel.

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Low cost TiAl-based precision cast turbocharger wheels for automotive industry

As-cast conical ingots.

Extracted sample for mechanical testing from as-cast turbocharger wheel.

Initial ingot subjected to HIP-ing at 1280 °C for 4 h at 200 MPa.

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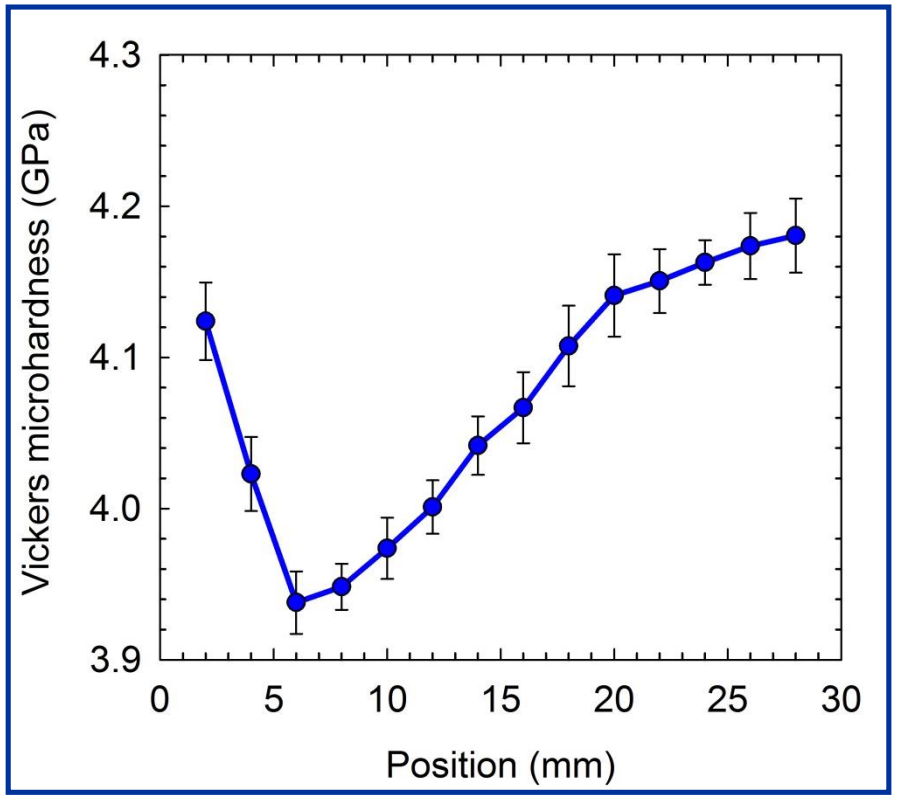
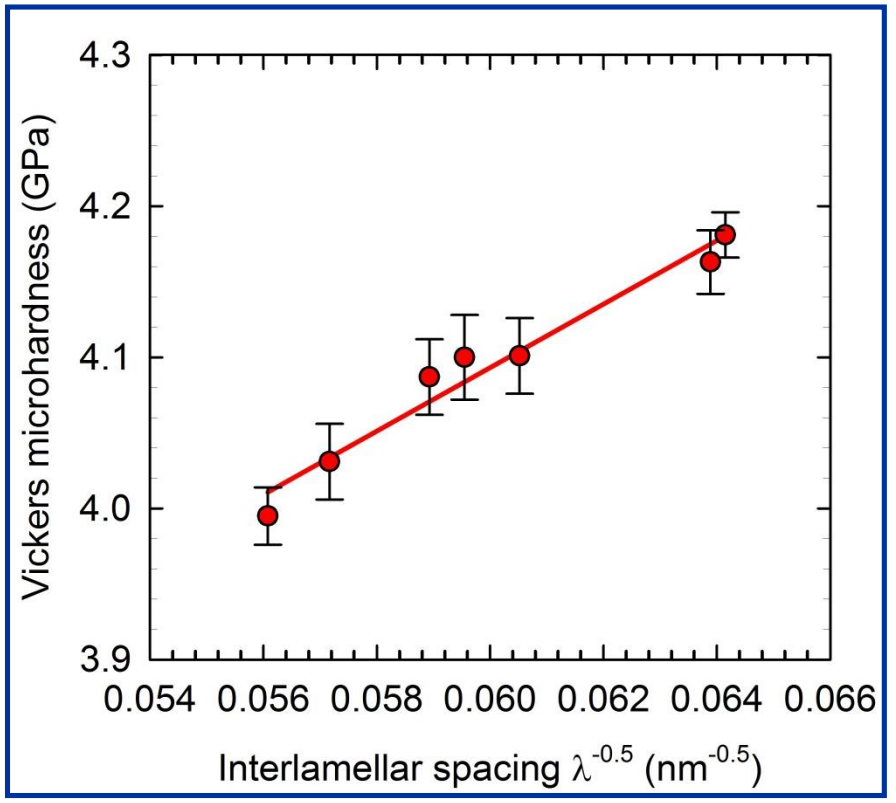
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Vickers microhardness evolution with the position in the as-cast turbocharger wheel.



Dependence of Vickers microhardness on α2-α2 interlamellar spacing.

Laboratory of Metallic Materials

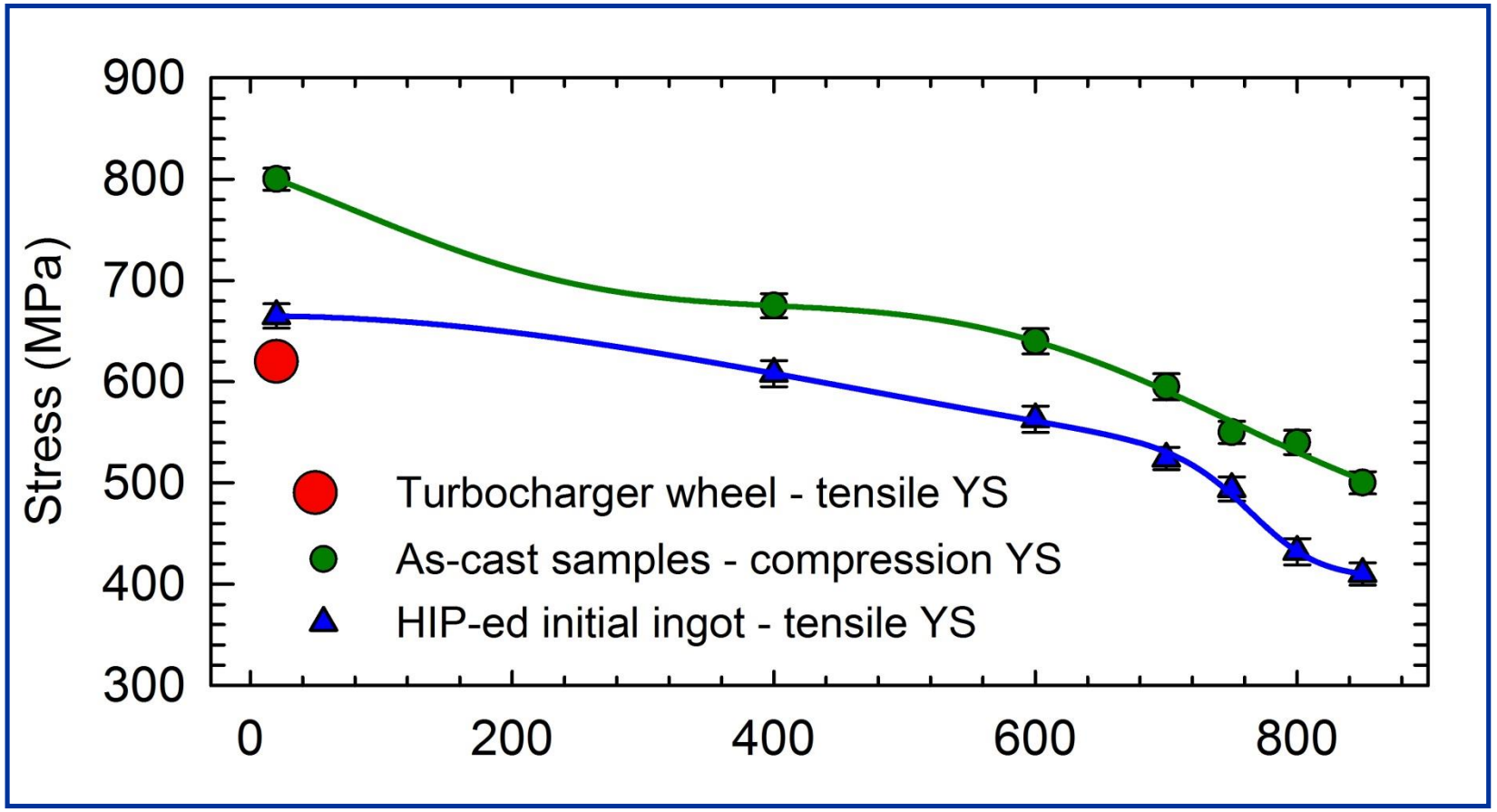
Low cost TiAl-based precision cast turbocharger wheels for automotive industry

Room temperature (RT) yield stress (YS), ultimate tensile stress (UTS) and plastic elongation to fracture

Sample	Origin	YS (MPa)	UTS (MPa)	Elongation (%)	Notes
C1	as-cast conical ingot	-	-	-	fractured during machining
C2	as-cast conical ingot	-	-	-	fractured during machining
C3	as-cast conical ingot	-	-	-	fractured during machining
C4	as-cast conical ingot	0	384	0	premature fracture during testing
T4/13	as-cast turbocharger wheel	620	629	0.23	cut from central part of the wheel

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry



Temperature dependence of 0.2% offset compression yield stress for as-cast samples and 0.2% offset tensile yield stress for HIP-ed initial ingot.

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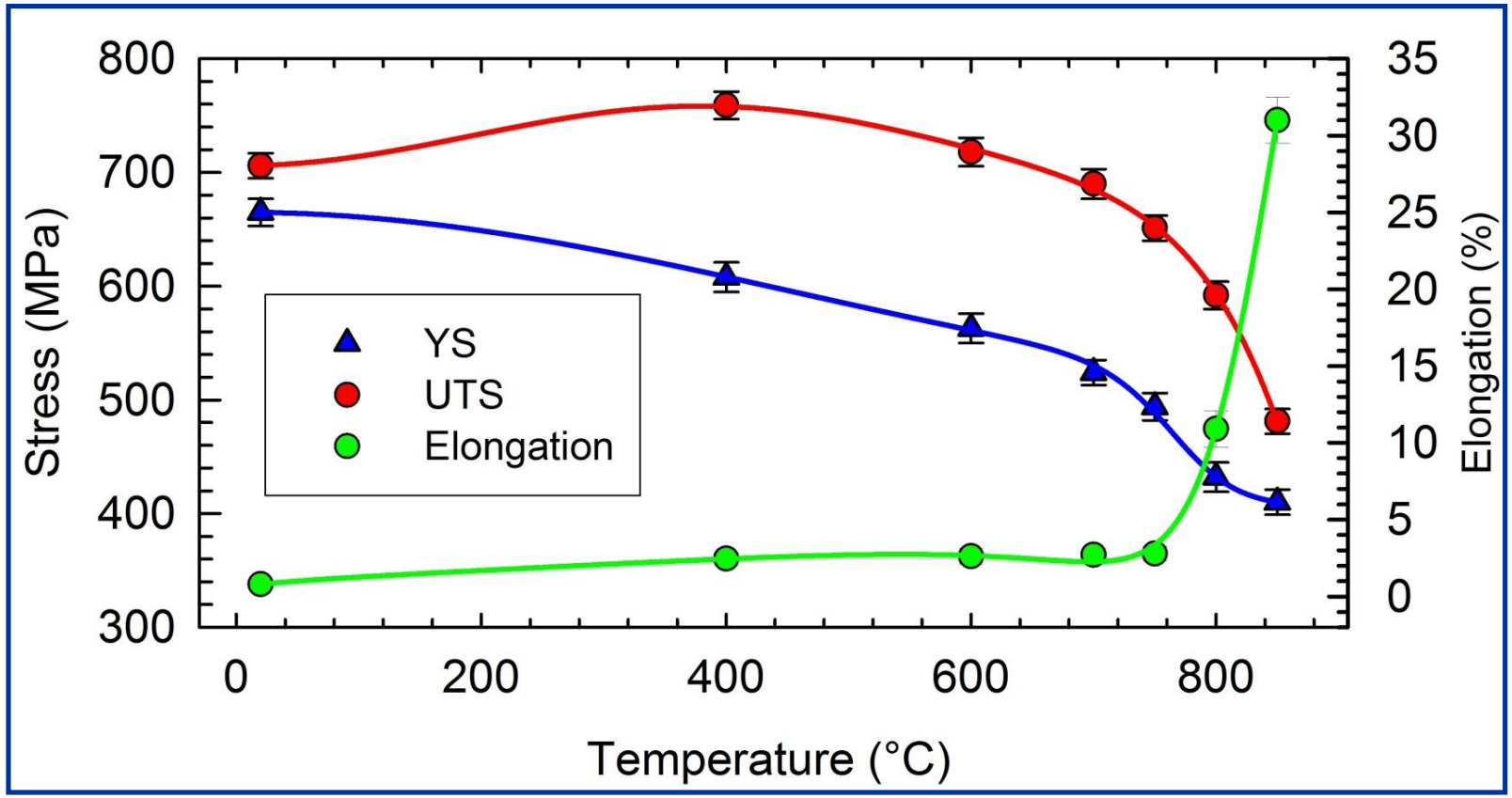
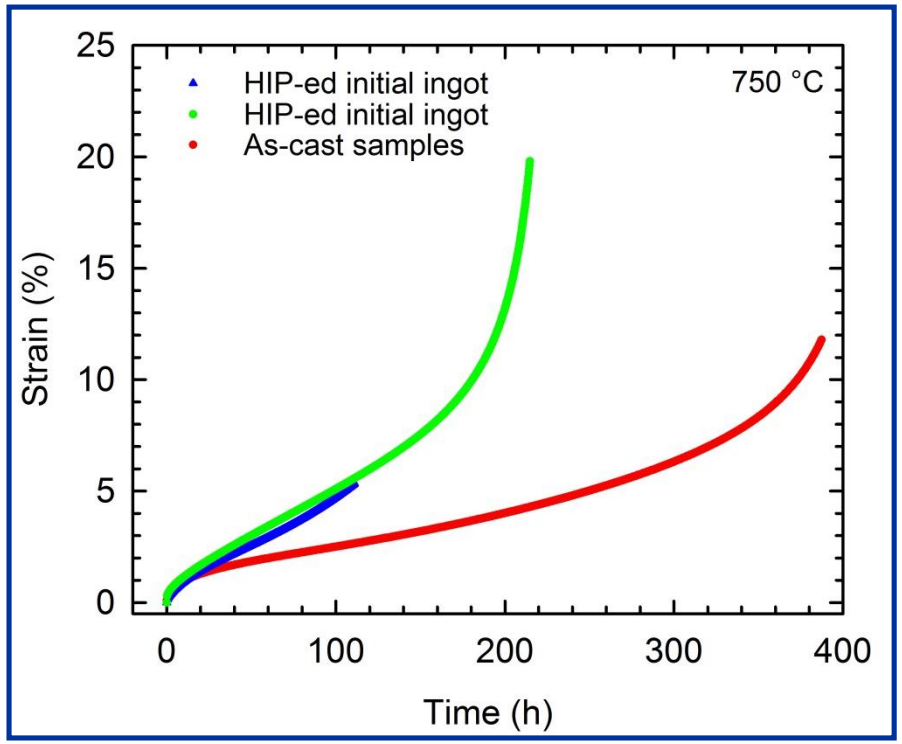
Low cost TiAl-based precision cast turbocharger wheels for automotive industry



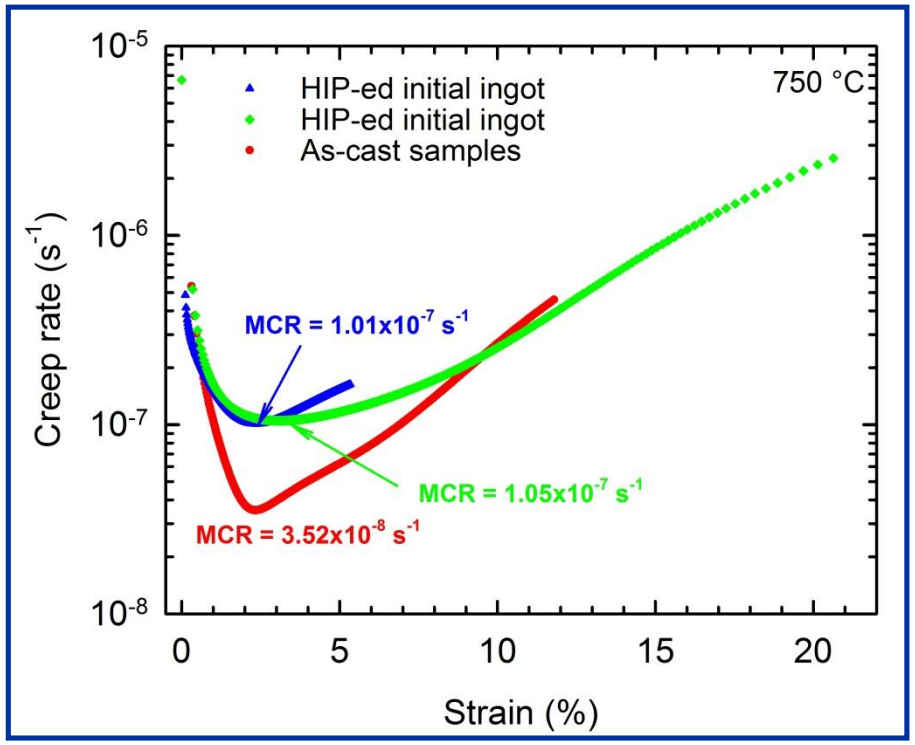
Temperature evolution of 0.2% offset tensile yield stress (YS), ultimate tensile stress (UTS) and plastic elongation to fracture for HIP-ed initial ingot.

Laboratory of Metallic Materials

Low cost TiAl-based precision cast turbocharger wheels for automotive industry



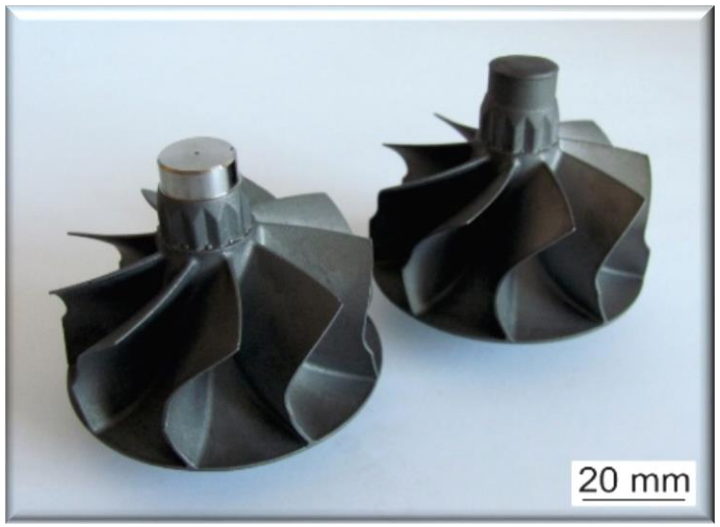
Creep deformation curves at 750 °C/300 MPa.

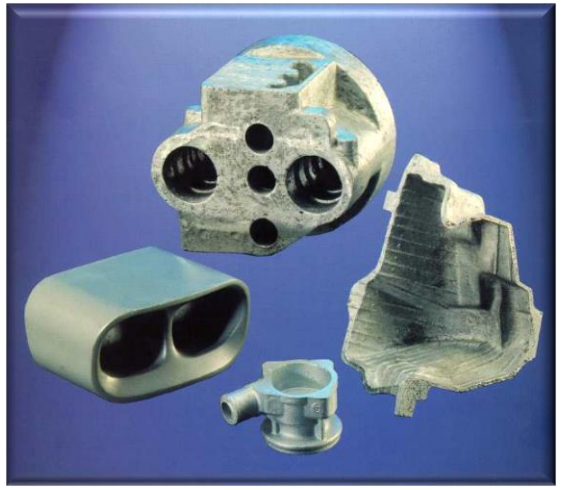


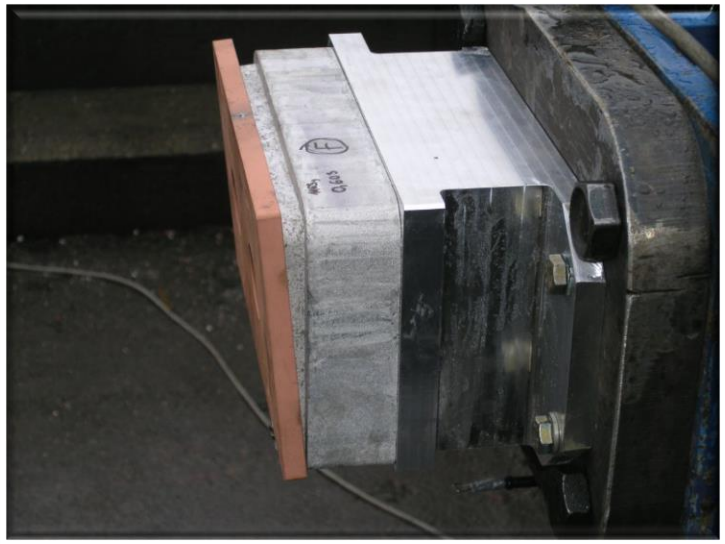
Evolution of creep rate with the strain at 750 °C/300 MPa. Minimum creep rates (MCR) are indicated in the figure.

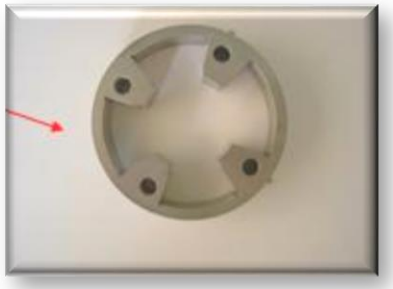
- The optimisation of the induction melting process in Y_2O_3 and Al_2O_3 based crucibles with inner Y_2O_3 layer results in contamination of cast turbocharger wheels by oxygen below 1300 wtppm and by Y_2O_3 particles of about 0.5 vol.%.
- The optimisation of Al_2O_3 based moulds with inner Y_2O_3 layer and preheating to a temperature of 950 °C before casting result in good surface quality of turboacherger wheels without misruns defects.
- The grain size, interlamellar spacing, volume fraction of β phase and volume fraction of γ_b along grain boundaries vary from the centre of the turbocharger wheel towards the blading.
- The specimens prepared from as-cast conical samples show no RT ductility and premature fracture during machining or testing. Specimens prepared from cast turbocharger wheel showed RT ductility of 0.23%. The initial ingot after HIP-ing showed RT ductility of about 0.8% and BT to DT at a temperature higher than 750 °C.
- The as-cast samples showed improved creep resistance when compared to that of HIP-ed initial ingot.

Laboratory of Metallic Materials







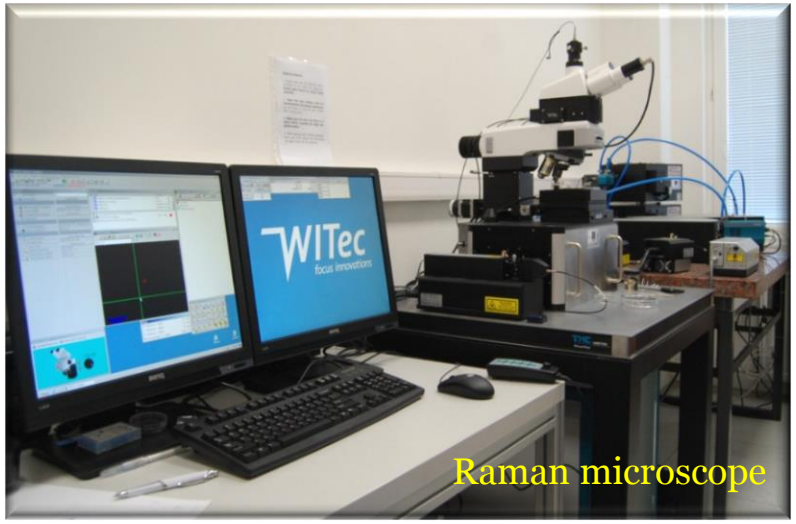


Laboratory of Exploitation of Nanomaterials

Ing. E. Majková, DrSc.
Ing. M. Omastová, DrSc.

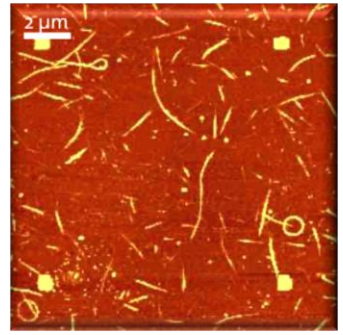

Plastograph

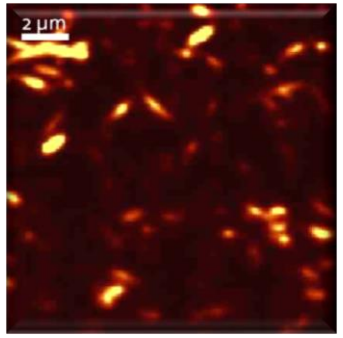
Impact pendulum



Raman microscope

Laboratory press





Objectives

- Development and characterisation of nanoparticles for applications in sensors and photovoltaic systems
- Preparation of polymeric materials with well dispersed various nanoparticles
- Characterisation of properties of nanomaterials

Laboratory of Exploitation of Nanomaterials

Electrically Conductive Composites

Polyolefin/carbon black

- low percolation concentration
- resistance against aggressive surroundings (electrodes)
- transformation of electrical energy to chemical energy

Polyolefin/graphite

- resistance against aggressive surroundings (electrodes)
- high level of thermal conductivity

Epoxy/metal coated filler

- conductive adhesives

Elastomers/carbon nanotubes, graphene and GO

- photo-actuating materials
- oil sensors, gas and liquid sensors
- solar cells

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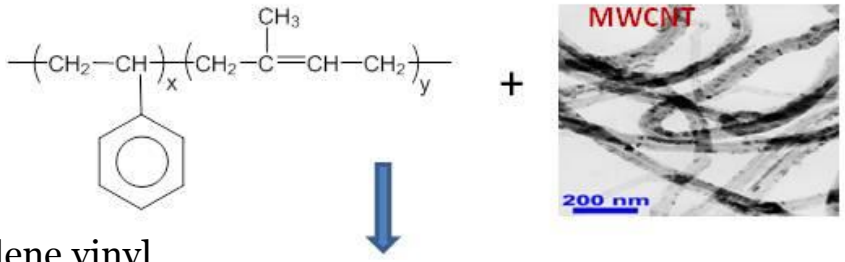
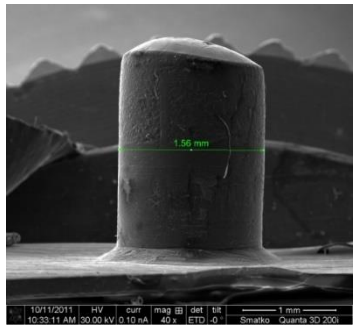
Photo-actuating materials on the base of CNT

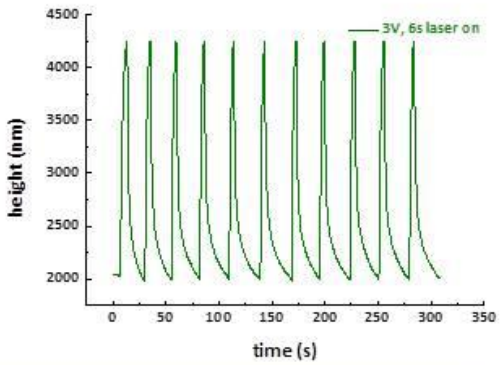
Photo-actuating nanocomposite



or ethylene vinyl acetate -EVA as polymeric matrix



Laser-induced photo-actuation



i.) the development of new photo-actuating materials

ii.) fast actuation, fast relaxation, an actuation amplitude around 10 %

iii.) a variability in the use of polymeric matrices

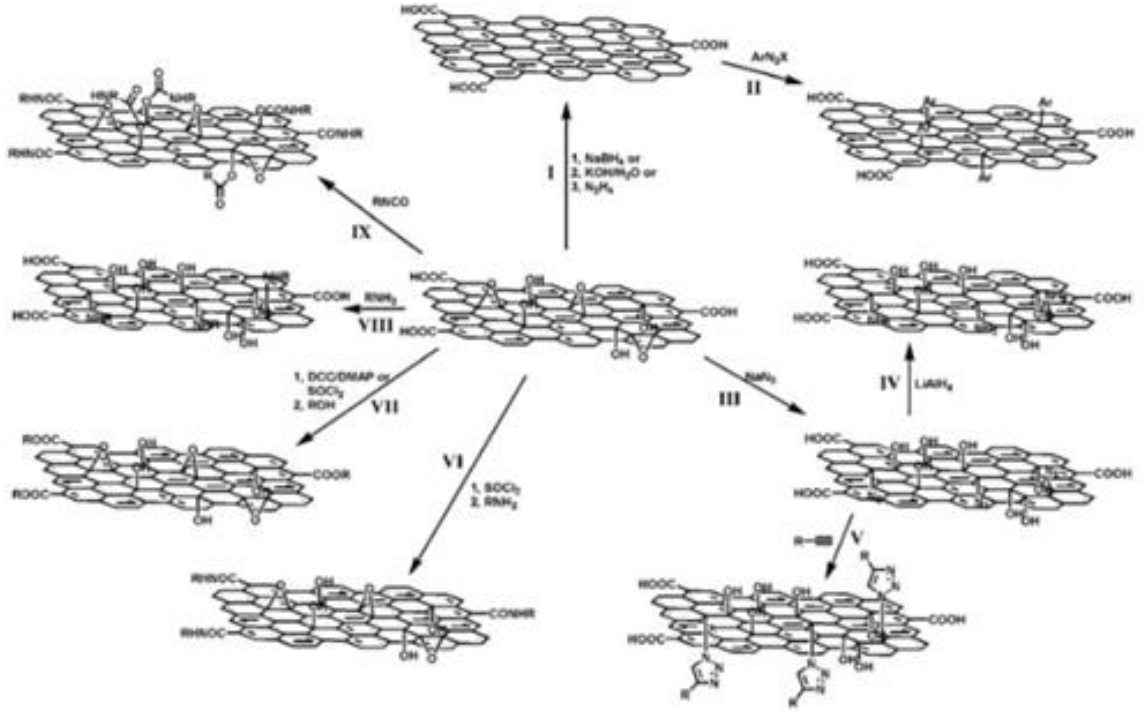
iv.) designing of new surfactants for CNT

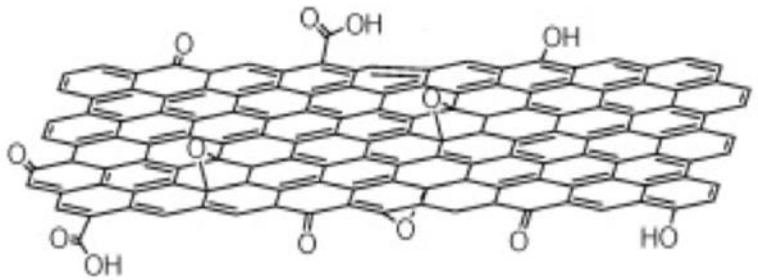
The development of haptic, refreshable display for visually impaired people

7FPNano-Optical Mechanical Systems (NOMS)
http://www.noms-project.eu/)

Laboratory of Exploitation of Nanomaterials

Covalent modification of graphene/graphene oxide (GO)

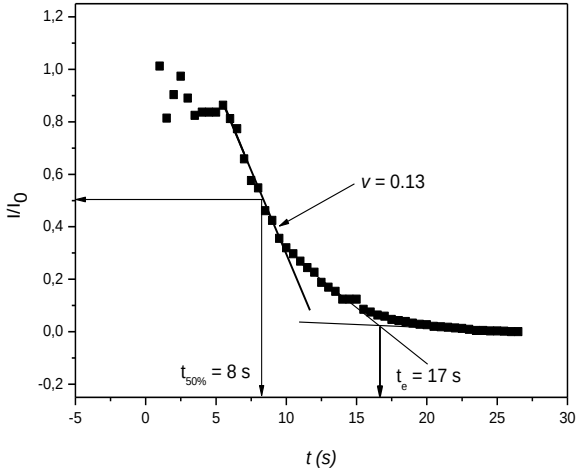


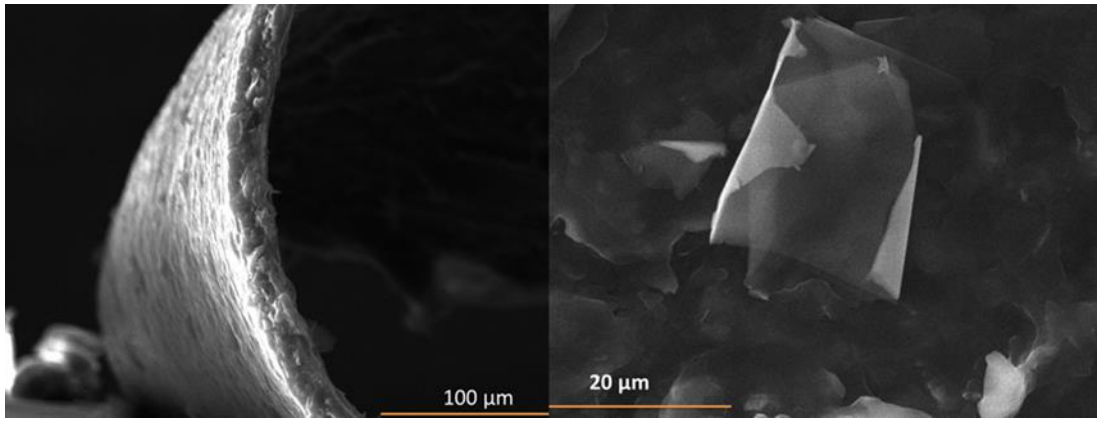


Preparation
of GO-multifunctional
nanoplatform
With magnetic nanoparticles
(MNps) and antibody (Y)
for antibody-mediated cancer
biosensing and bioimaging

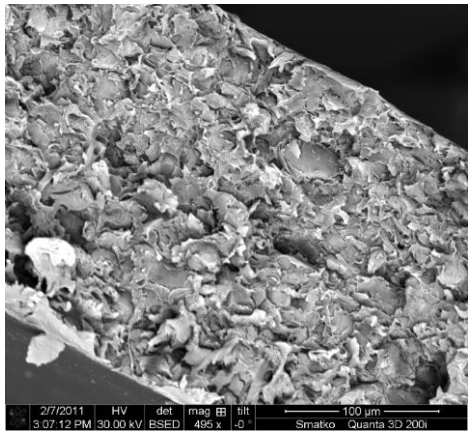
Laboratory of Exploitation of Nanomaterials

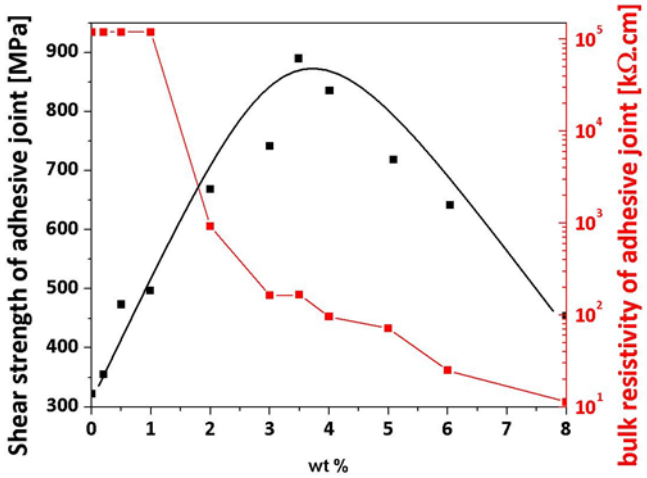
Detection of oil leakage based on graphene/polymer composite





Conductive ahdesives based on graphene/graphite





Smart texiles

Research and laboratory verification of preparing electroconductive nanosol, with Chemitex Žilina SK

Laboratory of Exploitation of Nanomaterials

Chemical liquid sensors

Requirements

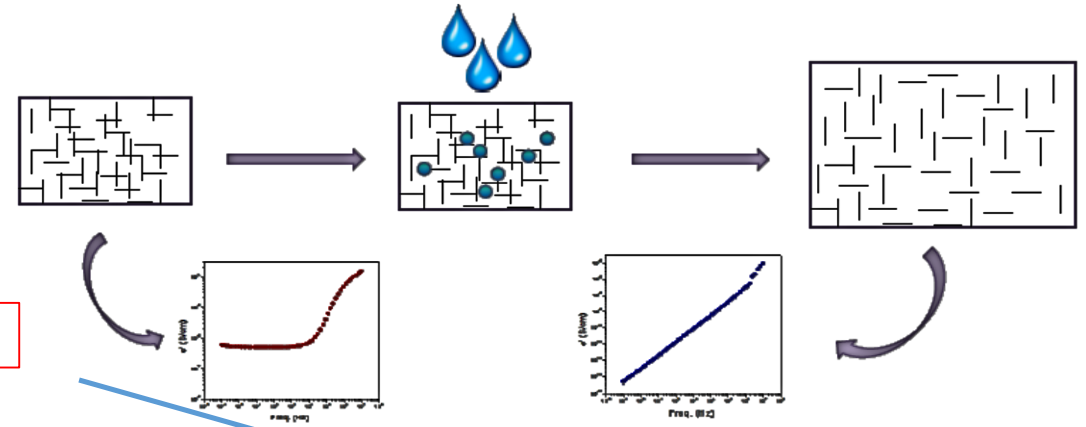
- high selectivity
- high sensitivity
- good manageability
- low price

Measurement principles

- **resistive** (metal oxide semiconductors, phthalocyanine, conductive polymers, **conductive polymer composites -CPCs**)
- capacitive
- optical (refraction index, luminescence,...)

Good solvent – solubility parameter close to that of polymer matrix

Elastomers/carbon nanotubes or carbon black



To prevent dissolution of the material:

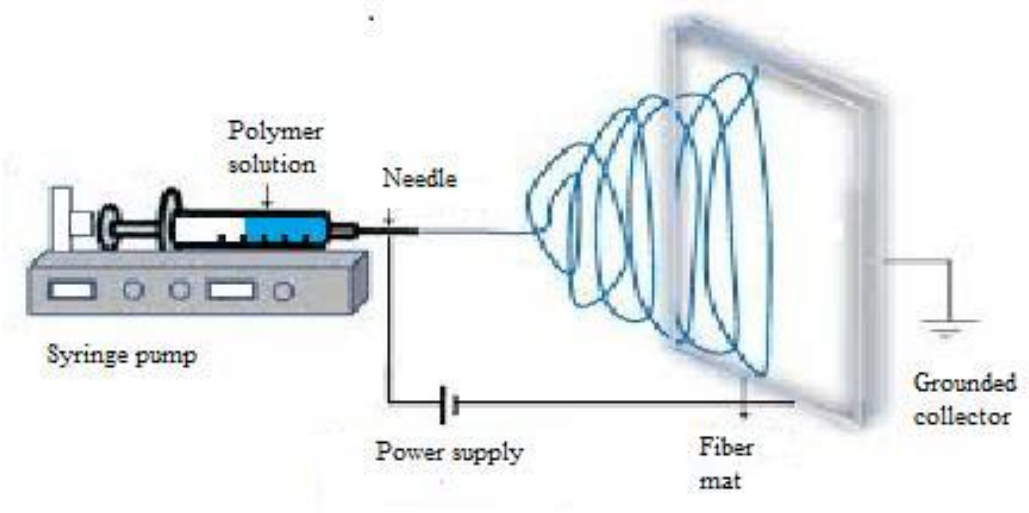
a) Crosslinked Styrenebutadiene rubber (SBR)/CNT, SBR/CB

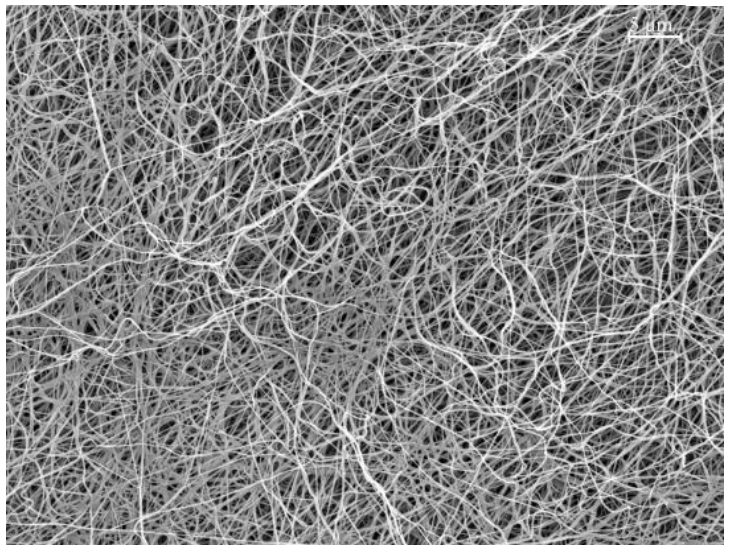
b) amphiphilic Styrene-ethylene/butylene-styrene with Maleic anhydride (SEBS-MA) modified with polyethyleneglycole/CNT

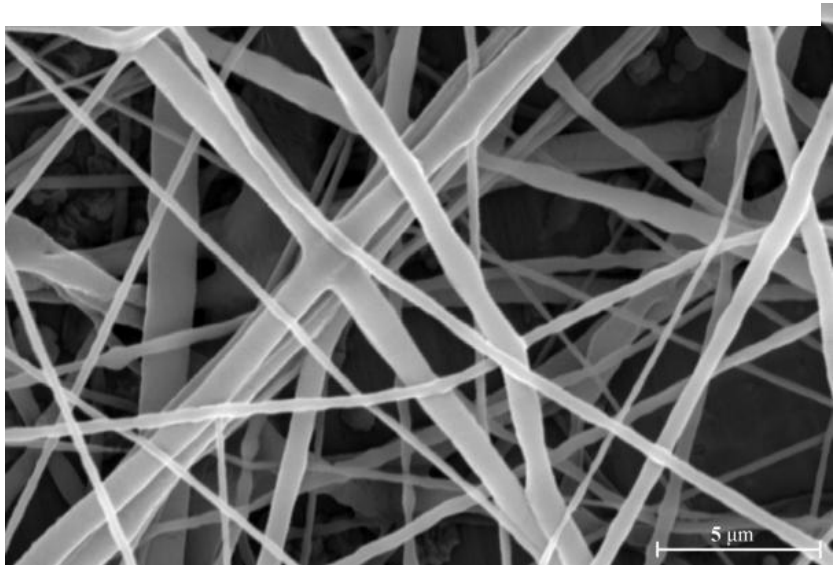
Laboratory of Exploitation of Nanomaterials

Electrospinning of polymers

Preparation of conducting nonwoven porous mats for application as sensors and in bionics

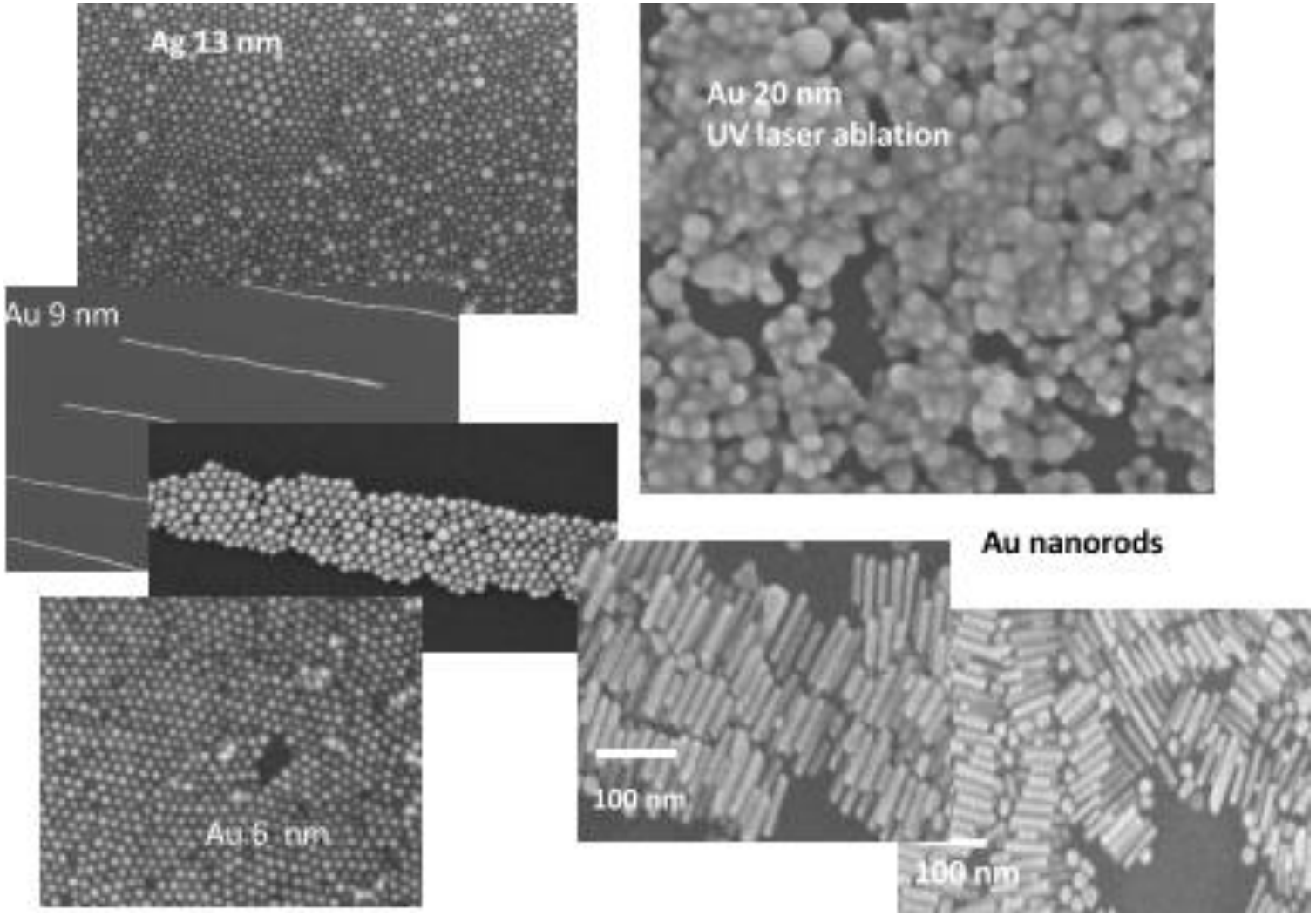






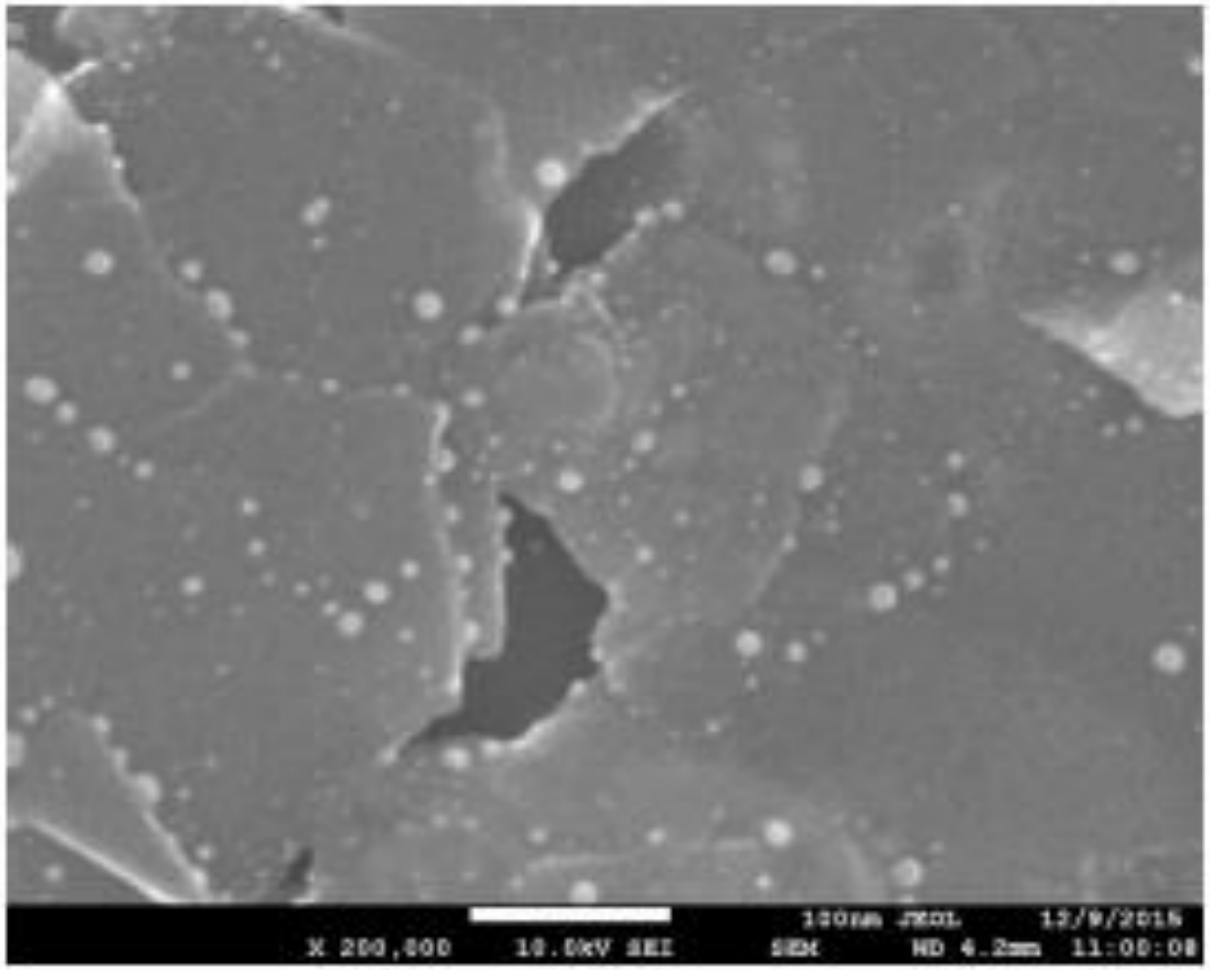
Laboratory of Exploitation of Nanomaterials

Processing of nanoparticles and nanorods



Laboratory of Exploitation of Nanomaterials

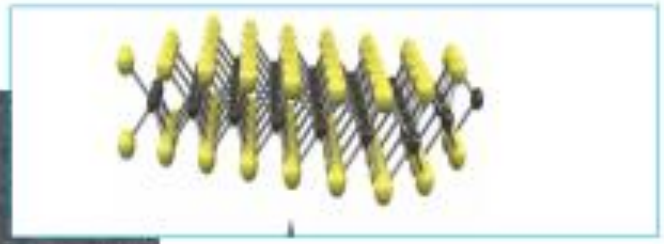
Few-layer graphene Langmuir nanonfilm decorated by paladium nanoparticles for NO2 and H2 gas sensing

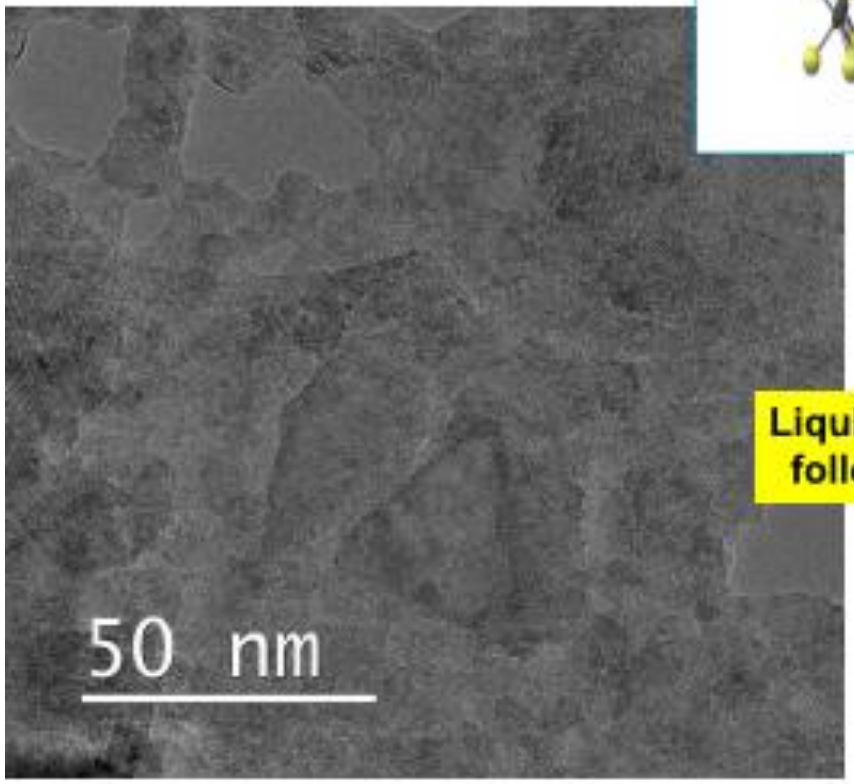


Laboratory of Exploitation of Nanomaterials

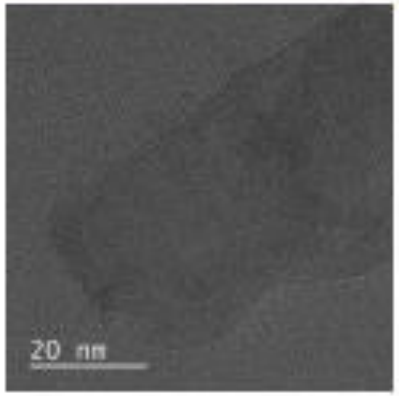
Nanosheets

Few layer nanosheets MoS2 film



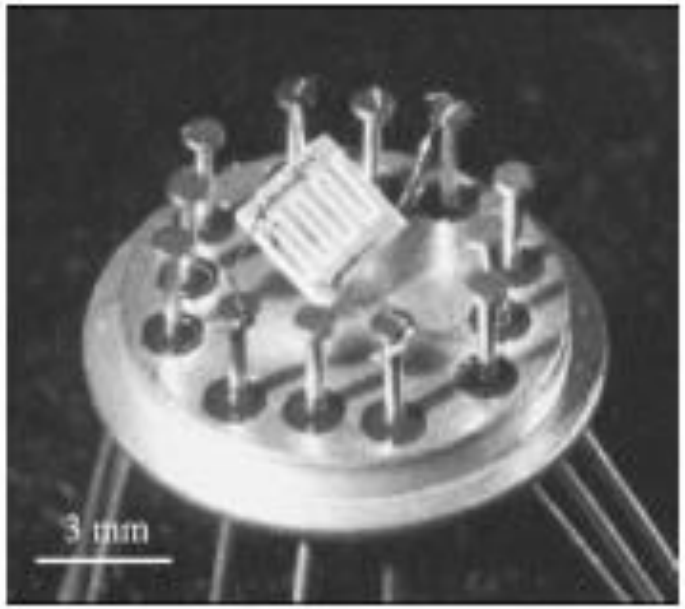


Liquid exfoliation by sonication
followed by centrifugation



Laboratory of Exploitation of Nanomaterials

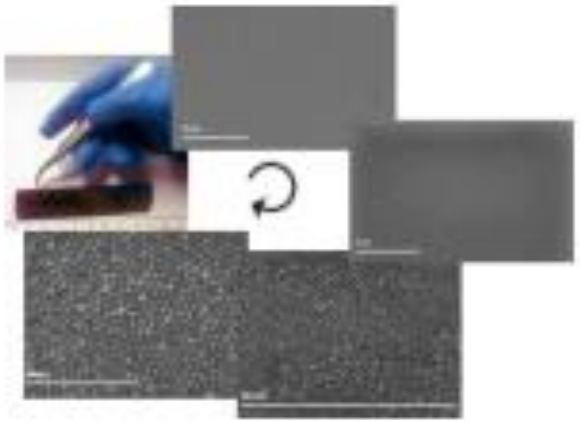
Nanoparticle based explosive gas sensors for COx and NOx detection

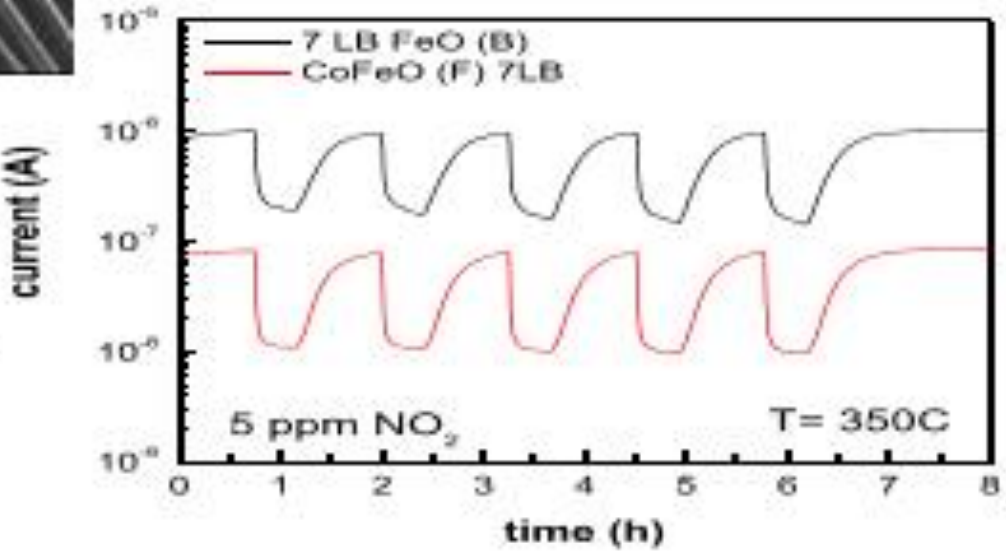


Co-Fe-O 7 ML, 5 ppm, NO2, 350 °C
Fe-O 7 ML, 500 ppb, NO2, 350 °C

applications in detection of explosives

NO2 in ppb range, aim is 100 ppb,
CO in 150ppm range





Laboratory of Exploitation of Nanomaterials

Coatings

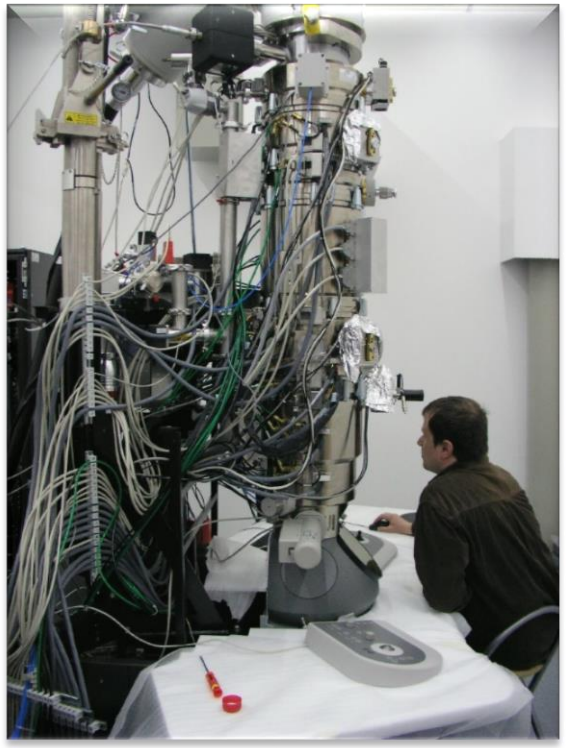
Superhydorphobic coatings based on nanoparticles

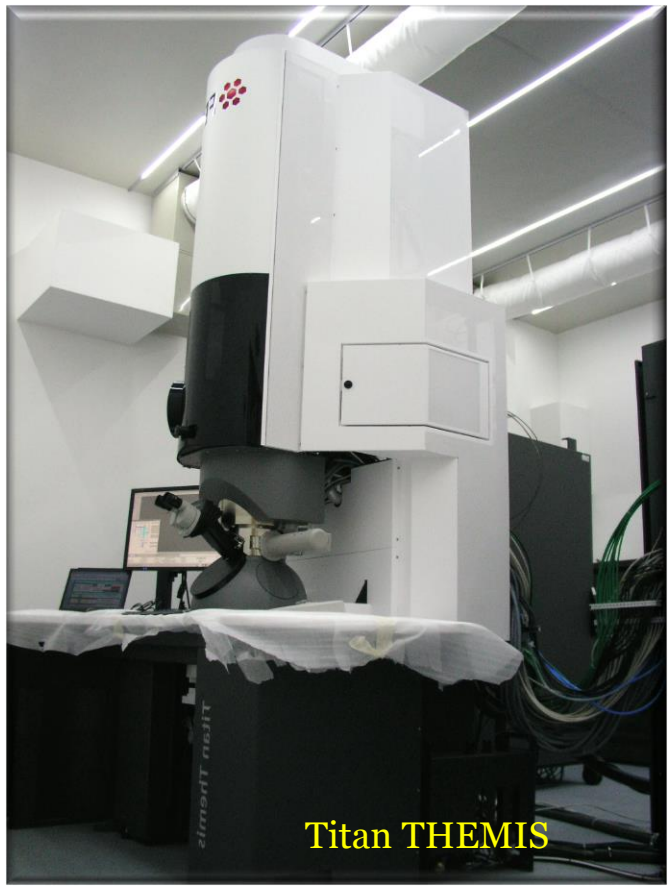
Contact angle 175 deg achieved

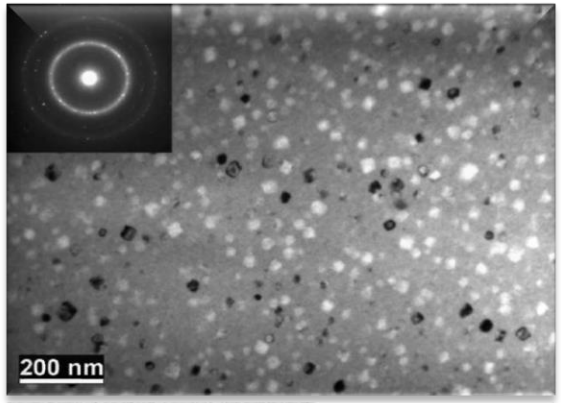
Up to 6% PCE improvement with superhydrophobic coating for OPV cell

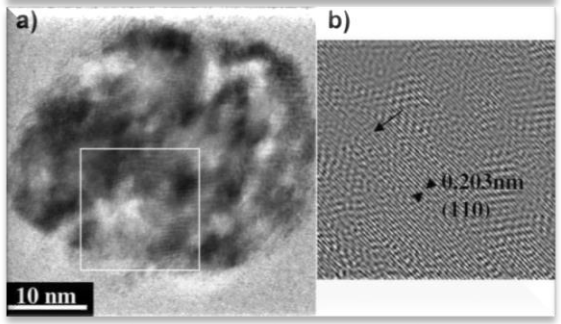
Laboratory of Structural Analysis of Materials

Ing. K. Iždinský, CSc.
Ing. P. Švec, DrSc.



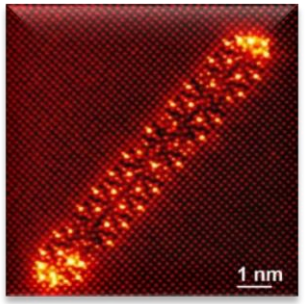


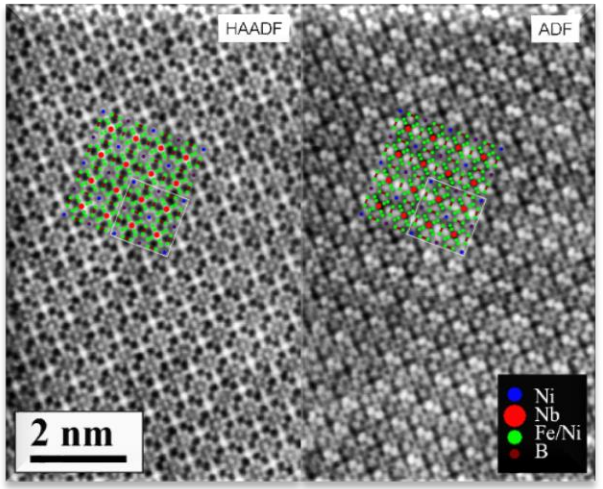




Objectives

- To put into operation new analytical equipment – TEM with atomic resolution
- Development of procedures for observations and analysis of various materials
- Microstructural characterisation of materials





Technology Transfer Office

Ing. K. Müllerová
TTO

gas sensor
PALLADIUM - FREE

Low cost

Power efficiency

Easy technology

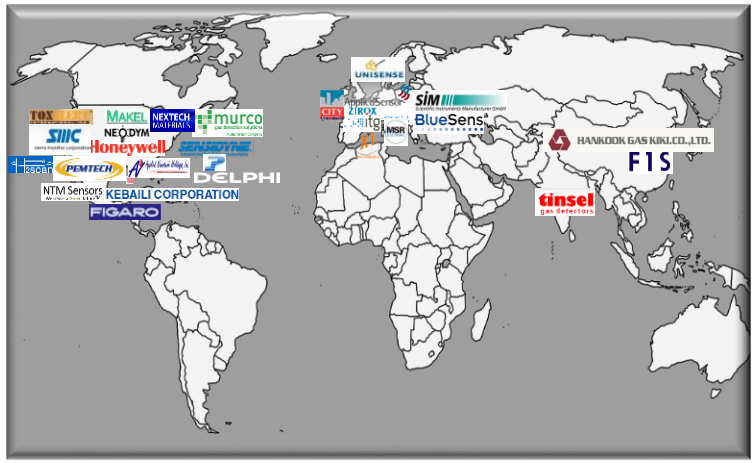
Pavol Kunzo

Peter Lobotka

Objectives

- Appraisal of inventions (technologies) from the point of view of their possible patenting (commercial and technical evaluation)
- Patenting of inventions
- Licensing of patented inventions (technologies)
- Support for potential spin-off companies based on the inventions (technologies)
- Common marketing of the organisations of SAS in foreign countries
- Lobbing and interactions with national institutions in the field of technology transfer

Patent Cooperation Treaty pending



Thank you for attention