

**The Head of the Department:**□

[Associate Prof. Roman Major, Ph.D.,D.Sc.](#)

**Scientific Staff:**

[Associate Prof. Maciej Szczerba, Ph.D.,D.Sc.](#)

Aldona Mzyk, Ph.D.

Klaudia Trembecka-Wójciga, Ph.D.

[Professor Ewa Beltowska - Lehman, Ph.D., D.Sc.](#) - Professor Senior

**Engineering - technical Staff:**

Małgorzata Pomorska, M.Sc.

**PhD and MSc students:**

Agnieszka Brzoza, M.Sc.

Mgr inż. Gabriela Imbir, M.Sc.

Aleksandra Drewienkiewicz, B.Sc

Sebastian Sumara, B.Sc

Monika Wołowicz, B.Sc

## Research issues of the Department:

### Functional bio-materials with coatings for special applications in vascular systems and bone implants

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Micro- and nanocrystalline materials produced by laser ablation

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New biomedical blood contacting materials

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New bone implants

## Topics:

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Biomedical blood contacting materials (**prof. Bogusław Major;**  
**Dr. Roman Major** )

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Multilayer tribological materials ((**prof. Bogusław Major; Dr.Lukasz Major** )

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Materials with shape memory effect on the basis of single crystals and thin layer structures (**prof. Bogusław Major; Dr.Maciej Szczerba**)

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Anti-corrosion coatings produced by electrochemical method (**Ass.Prof. Ewa Bełtowska-Lehman** ;  
**M.S.Paulina Indyka - PhD -student**)

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Stress related phenomena (**prof. Bogusław Major; Dr.Anna Goral**)

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Thermodynamical properties of intermetallic phases  
(**Ass.Prof.Władysław Gąsior, M.S.Adam Dębski**)

## **Current Research Projects /in progress/:**

**KMM-VIN Project FP7 MATTRANS, Materials for Transportations (2009-2012)**

**ERA-NET MNT/FP6, partner Austria/ „Nanostructural materials for implants and cardiovascular biomedical devices (CardioBioMat) (2009-2012)**

## **Other research topics:**

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Antycorrosion coatings produced by electrocrystallization (  
**Ass.Prof.Ewa Bełtowska-Lehman**)

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Residua Stress topography (**Dr.Anna Góral**)

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Thermodynamic properties of intermetallics Właściwości  
termodynamiczne faz międzymetalicznych (**Ass.Prof.Władysław**

**Gasior Prof.PAN; M.S.Adam Dębski)**

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## **PhD thesis**

### **PhD thesis completed:**

2007 - Roman Major PhD; Optimization of structure and phase constitution of biomaterials on the titanium and polyurethane substrate

2007 - Łukasz Major PhD; Structure and properties of multilayer composite materiale produced by laser ablation

2007 - Robert Kosydar PhD, Contribution of deposition conditions of boron nitride layers on structure and properties

2007 - Anna Góral PhD, Relation of microstructure on directional crystallization rate of plate eutectics in Al-CuAl<sub>2</sub> alloys

2011 - Maciej Szczërba PhD; Structure and properties of magnetic single-crystals of Ni-Mn-Ga alloys /supervisor: prof.Bogusław Major/

**PhD thesis in progress:**

M.S. Paulina Indyka; Contribution of electrodeposition on microstructure and properties of Ni-W coatings /supervisor: Ass.Prof. Ewa Bełtowska-Lehman/

M.S. Adam Dębski; Formation enthalpy of Al-Fe-Ti-Ni intermetallic

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## **The most important achievements:**

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Description of laser modification processes of the aluminum alloys, carbon steel, construction alloy steel and high speed steel structure which is based on laser remelting and laser alloying.

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Analysis of the influence of the laser deposition conditions in connection with the description of the ablation phenomenon (PLD technique) on the microstructure, phase formation in the non-equilibrium conditions and the range of the residual stress in



coatings.

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Development of the X-ray method of the residual stress measurements and experimental revision based on the analysis of the residual stress in thin coatings produced by different deposition techniques.

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Analysis of the residual stress in the multiphase materials

-

Bio-medical coatings

## **Selected publications in the recent years**

B.Major, W.Mróz, T.Wierzchoń,  
W.Waldhauser, J.M.Lackner, R.Ebner,  
Surface and Coating Technology,  
180-181(2004)580-584,

Pulsed laser deposition of advanced  
titanium nitride thin layers

J.M.Lackner, W.Waldhauser, R.Ebner,  
B.Major, T.Schöberl, Thin Solid Films  
453-454(2004)195-202, Structural,  
mechanical and tribological  
investigations of pulsed laser deposited  
titanium nitride coatings

B.Major, J.T.Bonarski, W.Waldhauser, J.M.Lackner, R.Ebner, Archives of Metallurgy and Materials, 49(2004)83-92, Contribution of pulsed laser deposition conditions to texture, morphology and residual stress developed in TiN layers

J.M.Lackner, W.Waldhauser, R.Ebner, B.Major, T.Schöberl, Surface and Coatings Technology, 180-181(2004)585-590, Pulsed laser deposition of titanium oxide coatings at room temperature - structural, mechanical and tribological properties

R.Kustosz, R.Major, T.Wierzchoń,  
B.Major, Academia, 3(2004)14-17,  
Designing a New Heart

R.Major, E.Czarnowska, A.Sowińska,  
R.Kustosz, J.M.Lackner, M.Woźniak,  
T.Wierzchoń, B.Major, e-Polymer  
No026(2005)1-8, electronic version,  
Structure and biocompatibility of TiN  
coatings on polyurethane produced by  
laser ablation

B.Major, Archives of Metallurgy and  
Materials 50(2005)35-46, Laser  
Technology in Generating Microstructure

## of Functionally Gradient Materials

B.Major, Chapter 7 ;Laser processing for surface modification by remelting and alloying of metallic systems, in "Materials Surface Processing by Directed Energy Techniques" Edited by Yves Paleau, Elsevier (2006)

L.Major, J.Morgiel, B.Major, J.M.Lackner, W.Waldhauser, R.Ebner, L.Nistor, G.Van Tendelo, Surface and Coatings Technology, 200(2006)6190-6195, Crystallographic aspects related to advanced tribological

multilayers of Cr/CrN and Ti/TiN types  
produced by pulsed laser deposition  
(PLD)

R.Major, J.Bonarski, J.Morgiel, B.Major,  
E.Czarnowska, R.Kustosz, J.M.Lackner,  
W.Waldhauser, Surface and Coatings  
Technology, 200(2006)6340-6345,  
Elastic TiN coating deposited on  
polyurethane by pulsed laser

J.M.Lackner, W.Waldhauser,  
M.Berghauser, D.Hufnagel, R.Major,  
L.Major, B.Major, Plasma Processes and  
Polymers, Wiley- VCH Verlag GmbH,

Wiley InterScience 4(2007)51-54,  
Growth Morphology, Adhesion and  
Mechanical Properties of  
Room-Temperature Pulsed Laser  
Deposition Cr-CrN Multilayer Coating

R.Major, F.Bruckert, J.M.Lackner,  
W.Waldhauser, M.Pietrzyk, B.Major,  
Kinetics of eucariote cells adhesion  
under shear flow detachment on the PLD  
deposited surfaces,  
Bull.Pol.Acad.Sci.Tech.56(2008)223-228

B.Major, F.Bruckert, J.M.Lackner,  
R.Ebner, R.Kustosz, P.Lacki, Coating on

TiN and Ti(C,N) basis for biomedical application to blood contact and TiN/CrN multilayered tribological systems produced by pulsed laser deposition, Arch.Metal and Mater.53(2008)39-48

L.Major, J.Morgiel, J.M.Lackner, M.Szczerba, M.Kot, B.Major, Microstructure Design and Tribological Properties of Cr/CrN and TiN/CrN multilayer films, Advances Engineering Materials, Vol.10, Nr 7 (2008)617-621

B.Major, R.Major, F.Bruckert, J.M.Lackner, R.Ebner, R.Kustosz,



P.Lacki, New Gradient Coatings on TiN and Ti(C,N) Basis for Biomedical Application to Blood Contact, Advances in Materials Science 7(2007)63-70

Ł.Major, J.Morgiel, J.M.Lackner, M.Kot, M.Szczerba, B.Major, Optimization of Ti-Cr-N Multilayer Wear Resistance Coatings Through Microstructure Control, Inż.Materiałowa, 157-158(2007)672-676

J.M.Lackner, W.Waldhauser, R.Berghauser, M.Kahn, F.Bruckert, R.Major, B.Major, Detachment Kinetics

of Eukaryote Cells from Biocompatible  
PVD Coatings; 50th Annual Technical  
Conference Proceedings ISSN  
07375921, Society of Vacuum Coaters  
(2007) 74-77

M.J.Szczerba, J.Żukrowski,  
M.S.Szczerba, B.Major, An investigation  
of Ni-Mn-Ga Single Crystals  
Compressed at Room Temperature  
Arch.Metallurgy and Materials,  
53(2008)253-257 Annual Report 2008;  
Polish Academy of Sciences,  
Warsaw,46-47

B.Major, Nanostructural materials for cardiovascular biomedical devices, Euromat 2009 /E21, Glasgow FEMS

R.Major, F.Bruckert, J.M.Lackner, P.Wilczek, P.Lacki, W.Waldhauser, B.Major, Relationship between surface morphology and biological cells adhesion in hydrodynamic conditions

L.Major, J.Morgiel, J.M.Lackner, W.Waldhauser, M.Kot and B.Major, Euromat 2009 /B16, Glasgow FEMS, Wear mechanism during ball-on-disc test of Ti/TiN composite multi-layer systems

produced by hybrid PLD

A.Góral, J.Deda, E.Bełtowska-Lehman, B.Major, Arch.of Metal.and Materials 53(2008)979-984, Analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT) and Prerequisite Tree (PT) for Selected Technologies of Coating and Layer Production, Arch.Metal.,and Materials 34(2009)439-447

M.J.Szczerba, J.Przewoźnik, J.Żukrowski, Cz.Kapusta, M.S.Szczerba, B.Major, The influence of high temperature plastic deformation on

magnetic properties of Ni<sub>2</sub>MnGa type  
single crystals

J.M.Lackner, W.Waldhauser,  
M.Schwarz, L.Mahoney, L.Major,  
B.Major, Vacuum 83(2009)302-307,  
Polymer pre-treatment by linear anode  
layer source plasma for adhesion  
improvement of sputtered TiN coatings

J.M.Lackner, W.Waldhauser,  
A.Alamanou, Chr.Teichert, F.Schmied,  
L.Major, B.Major,  
Bull.Pol.Ac.Ser.Techn.(2010),  
Mechanisms for self-assembling

topography formation in low-temperature  
vacuum deposition of inorganic coatings  
on polymer surfaces

J.Sarna, R.Kustosz, R.Major,  
J.M.Lackner, B.Major,  
Bull.Pol.Ac.Ser.Techn.(2010), Polish  
Artificial Heart - material, technology,  
diagnostics

Boguslaw Major, Krzysztof Kubiak , Jan  
Bonarski, Maciej Szczerba, Łukasz  
Major, Anna Góral, A.Rakowska,  
Inż.Materiałowa 175(2010)614-617,  
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M.J.Szczerba, B.Major, M.S.Szczerba,  
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compressed Ni<sub>2</sub>MnGa single crystals

Łukasz Major, Marcin Kot, Juergen  
M.Lackner, Bogusław Major, Polish  
Metallurgy 2006-2010 in Time of the  
Worldwide Economic Crisis (2010)  
455-472; Committee of Metallurgy of the  
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K.Świątkowski; Tribological Coatings on the Basis of Multilayer Systems

B.Major, R.Major, Bentham e-BOOK (2011) (in realization), Tailoring of Tissue-Surface Interaction in Blood Contacting Materials

Boguslaw Major, Roman Major, Juergen M.Lackner, Wolfgang Waldhauser, Marek Sanak, Bogdan Jakiela, Jan Marczak, Marek Kowalczyk, Michal Sobota, In Tech - Open Access Publisher (in realization 2011), Functional Blood Contacting Materials



# Fabrication and Diagnostics

## **Patents:**

P 371147 „Pompa krwi, zwłaszcza pneumatyczna komora wspomagania serca" Zgłoszenie: Fundacja Rozwoju Kardiochirurgii, Zabrze; Instytut Metalurgii i Inżynierii Materiałowej PAN, Kraków,  
JOANNEUM RESEARCH  
Forschungsgesellschaft mbH, Graz AT

EP 1 912 687 B1 „Blond Pump in particular heart assist device”  
Foundation for Cardiac Surgery  
Development Zabrze, Institute of  
Metallurgy and Materiale Scence PAS  
Cracow, JOANNEUM RESEARCH  
Forschungsgesellschaft mbH,  
Graz/Leoben

P 366528 „Sposób wytwarzania  
ochronnych kompozytowych warstw  
powierzchniowych na stopach tytanu na  
implanty kostne”; Zgłoszone na rzecz  
Politechniki Warszawskiej; Twórcy:  
T.Wierzchoń, B.Major, W.Mróz,  
E.Czarnowska, J.R.Sobiecki

