

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)

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-CuAl₂ alloys

2011 - Maciej Szczerba 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

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.Kustoscz, 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.Kustoscz,

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 Ni₂MnGa 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,
AMT2010, Directionally solidified

CMSX-4 Nickel Based Superalloys; Microstructure, Orientation, Residual Stress, Microanalysis

M.J.Szczerba, B.Major, M.S.Szczerba,
Inż.Materiałowa 175(2010)280-283,
AMT2010, A note on the kink bands in
compressed Ni₂MnGa 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
Polish Academy of Sciences; Editor

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
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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

