Wrocław University of Science and Technology

Division of Vacuum Technology and Diagnostisc of Nanomaterials

Faculty Electronics, Photonics and Micorsystems

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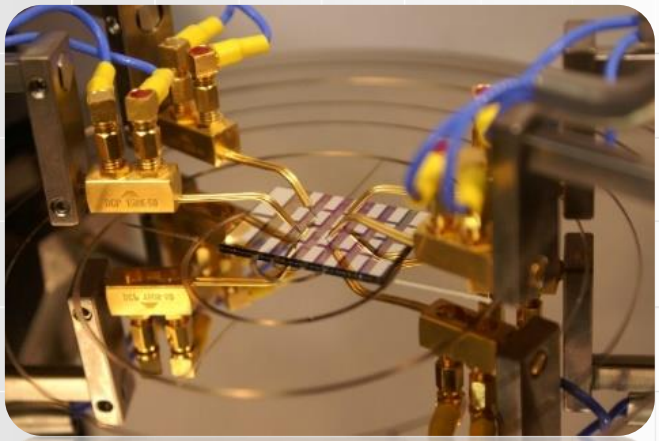
Poland



HR EXCELLENCE IN RESEARCH

Division of Vacuum Technology and Diagnostics of Nanomaterials

Research Team

Prof. Danuta Kaczmarek, PhD, DSc., Eng. (retired)
Prof. Witold Posadowski, PhD, DSc., Eng. (retired)
Prof. Jarosław Domaradzki, PhD, DSc., Eng.
Associate Professor of WUST Artur Wiatrowski, PhD, DSc., Eng.
Associate Professor of WUST Michał Mazur, PhD, DSc., Eng.
Associate Professor of WUST Damian Wojcieszak, PhD, DSc., Eng.
PhD Eng. Agata Obstarczyk
MSc Eng. Grzegorz Klubiński
MSc Eng. Paweł Chodasewicz
MSc Eng. Ewa Mańkowska
MSc Eng. Patrycja Pokora

PhD Students:
MSc Eng. Aneta Lubańska
MSc Eng. Szymon Kiełczawa
MSc Eng. Malwina Sikora (applied doctorate)
MSc Eng. Jędrzej Kowalewski (applied doctorate)
MSc Eng. Marcin Prządka (applied doctorate)
MSc Eng. Paulina Kapuścik
MSc Eng. Maurycy Maziuk

Division of Vacuum Technology and Diagnostics of Nanomaterials

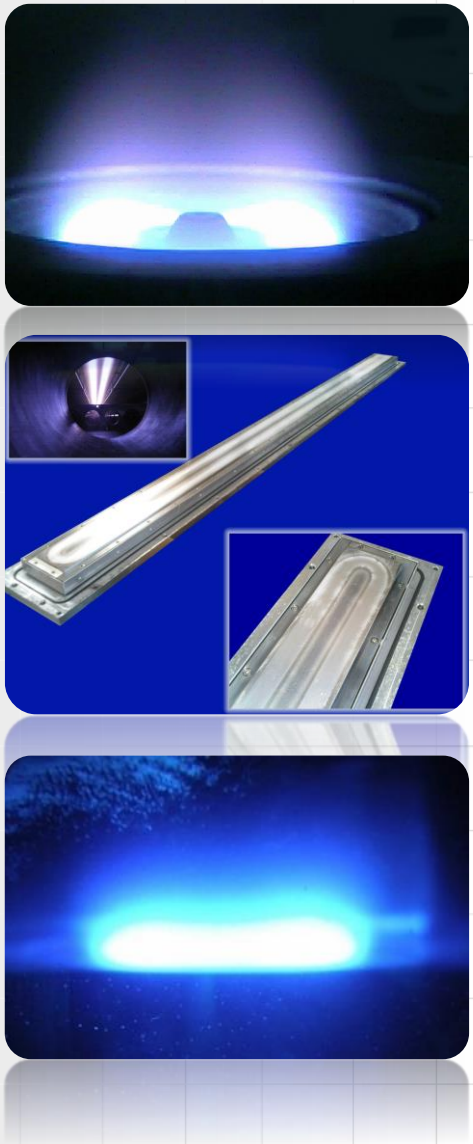
Research activity profile:

Vacuum deposition of thin films by PVD methods
(magnetron sputtering, electron beam evaporation)

- metal layers, dielectric and (semi)conducting thin layers,
- composites of metal nitrides, oxides,
- carbides and carbide-nitrides
- microelectronic passive structures for new generation microsensors,
- fabrication of TCO (Transparent Conducting Oxide) and TOS (Transparent Oxide Semiconductor)

Research on plasma deposition processes

- study of deposition processes of thin film coatings using PVD methods,
- designing, construction, modernisation and manufacturing of vacuum components (electron guns, magnetron guns)



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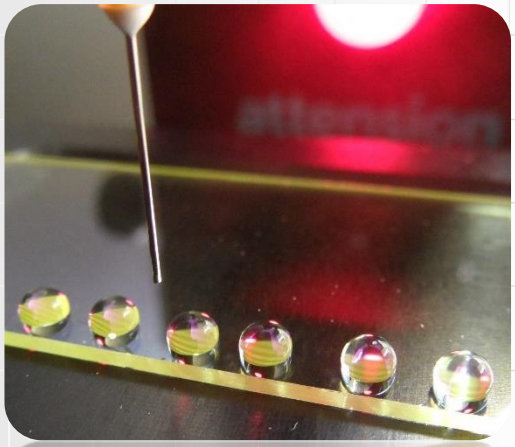
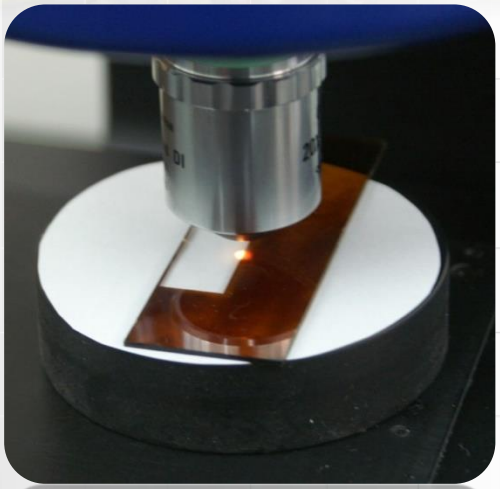
Research activity profile:

Research on thin film optical coatings for different purposes:

- transparent electronics,
- wear and scratch resistant hard coatings,
- photocatalytic coatings,
- chromogenic coatings,
- luminescence coatings,
- hydrophobic/hydrophilic coatings,
- thin films for photovoltaics,
- antibacterial coatings,
- ... and many more.





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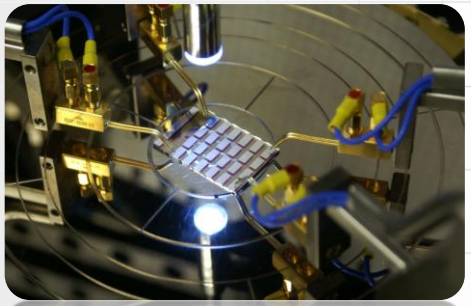
Research activity profile:

Diagnostics

- optical properties (transmission/reflection measurements)
  - n&k analysis using reverse engineering method
  - designing of optical thin films
- electrical properties (dc, ac, thermoelectrical, Sebeeck, Hall effect measurements)
  - impedance spectroscopy analysis (equivalent circuit models)
  - analysis of electrical charge carriers transport mechanisms
- mechanical properties (abrasion, wear resistance), and surface (topography, wettability) properties
- analysis of microstructure (XRD, Raman spectroscopy, TEM) and surface properties (AFM, XPS, UPS)
- gas sensing and chromogenic properties



Division of Vacuum Technology and Diagnostics of Nanomaterials

Division structure:

Research Laboratiories

- Laboratory of Vacuum and Plasma Technologies
- Laboratory of Thin Film Optical Coatings
- Laboratory of Optical and Electrical Diagnostics of Nanomaterials
- Laboratory of Nanomaterials Technology
- Laboratory of Photovoltaics (SolarLab)

Teaching Laboratories

- Open Laboratory
- Laboratory of Wireless Systems Technology and Internet of Things

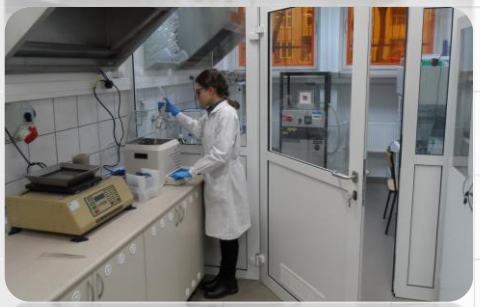
Division of Vacuum Technology and Diagnostics of Nanomaterials

Main technological equipment:

- several vacuum deposition systems for thin films using:
  - Magnetron Sputtering (MS) (Balzers)
  - Electron Beam Evaporation (EBE) (SHINKU)
  - Ion Beam Assisted Deposition (IBAD) (Satis)

- wet (sol-gel, dip-coating) facility for deposition of thin films

- facility for preprocessing and post-deposition treatment of thin films (Nabertherm furnance)



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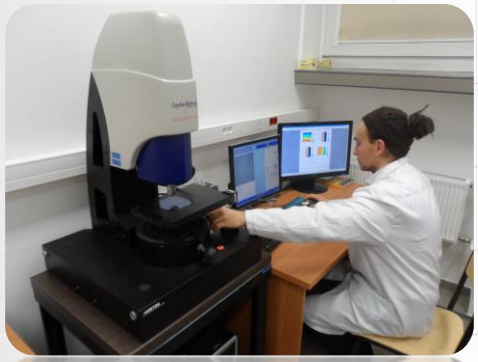
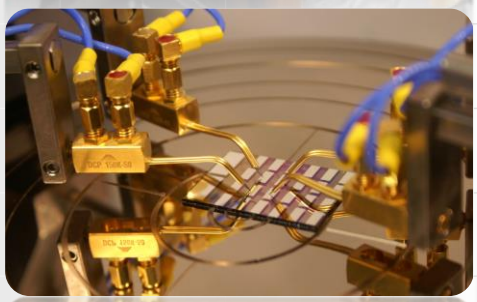
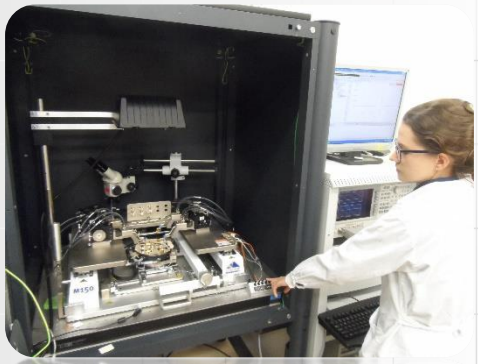
Thin film characterisation:

- Surface geometry measurements – Taylor Hobson Taly Surf CCI Lite optical profiler,
- I-V Keithley 4200 SCS Semiconductor Characterisation System (100 aA – 100 mA),
- Impedance spectroscopy setup Agilent 4294A
- Optical spectrophotometers and radiometers (Ocean Optics, Newport) 200 nm – 3200 nm,
- Setups for resistivity, Hall, Seebeck measurements (Jandel, Keithley, Instec),
- Physico-chemical properties of thin films (wetting angle, wear resistance ...),
- Setups for I-V characterisation of photovoltaic structures (Steuernagel Lichttechnik, class A solar symulator),
- Setup for Light Beam Induced Current, IR and VIS spectral mapping of photovoltaic structures,
- ...







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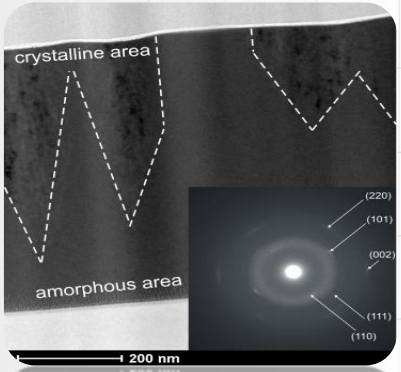
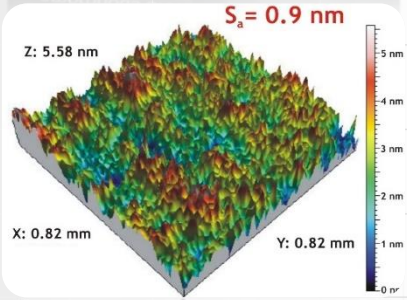
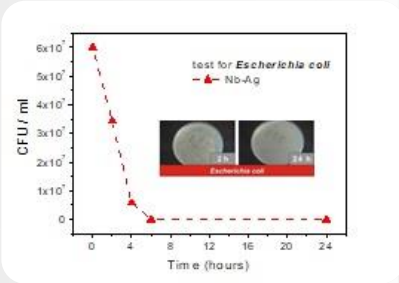
Experience in analysis:

- Optical properties using reverse engineering (n&k nalysis, band-gap structure),
- Designing of optical thin film coatings,
- Microstructure (XRD, TEM, HRTEM),
- Elemental composition (EDS),
- Surface chemical properties (XPS, UPS),
- Surface geometry properties (AFM, optical profilometry),
- Gas-sensing properties,
- Impednace spectroscopy







Division of Vacuum Technology and Diagnostics of Nanomaterials

List of selected Research and Applied grants:

- "A new approach to the development of a universal model of the gasochromic phenomenon based on a comprehensive analysis of the coloring mechanism in metal oxide thin films", 2021-2024
- "Analysis of electronic transport properties in a new generation gradient thin film memristor structures", 2019-2022
- "New materials in form of nanocrystallline thin films based on titanium with various copper content, of controlled antibacterial and cytotoxic properties", 2017-2021
- "Testing the hardness of optical coatings based on titanium obtained by innovative PVD methods
- "Study and analysis of the structure's impact on the functional properties of europium-doped nanocrystalline thin TiO_2 thin films", 2015-2017
- "Fabrication and characterization of electrical and optical properties of thin oxide films for transparent electronics", 2014-2017
- "Functional optical coatings for application in fireproof glass panes", 2013-2016

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List of selected granted patents:

- Process for the preparation of TiO2 thin films with high hardness and a thin layer of TiO2 with increased hardness, Patent No PL232898B1, publication: 2019-08-30
- Method for producing thin-film resistance structures with memory effect and a thin-film resistance structure with memory effect, Patent No PL237258B1, Publication 2021-03-22
- Device for measuring properties of convex antistatic samples, Patent No PL223722B1, Publication 2016-10-31
- Method for layer application in multi-target magnetron sputtering system, Patent No PL221077B1, Publication 2016-02-29
- Urological stent, Patent No PL217535B1, Publication 2014-07-31
- Process for the preparation of transparent and conductive thin layer based on TiO_2 and thin transparent and conductive layer based on TiO_2, Patent No PL220544B1, Publication 2015-11-30
- Method of manufacturing thin layer with chrome gas effect, and the thin layer with chrome gas effect, Patent No PL217297B1, Publication 2014-07-31
- Production method of thin layer with thermal-resistance effect and a thin layer with thermal-resistance effect, Patent No PL216050B1, Publication 2014-02-28

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