



Instytut Technologii Materiałów Elektronicznych



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Rok powstania: 1979 r.

Zarządzenie Nr 14 Prezesa Rady Ministrów z dnia 5 lutego 1979 roku

Nadzór nad funkcjonowaniem: Minister Gospodarki

Zatrudnienie: 279 osób

w tym pracowników naukowych: 165 osób.

Roczny przychód: ok. 50 mln zł,

w tym dotacja statutowa: ok. 10 mln zł.

Działalność: Technologie nowych materiałów



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HISTORIA

1. **A. K. Geim, K. S. Novoselov i in. – Science 2004**
2. **Podjęcie prac nad grafenem w ITME (dr Włodzimierz Strupiński) - 2006**
3. **A. Geim, K. Novoselov – Nature 2007**
4. **Podjęcie współpracy naukowej ITME z Geimem – 2009**
5. **Rozpoczęcie w ITME badań nad otrzymywaniem grafenu metodami chemicznymi (dr Ludwika Lipińska) – 2009**
6. **Nagroda Nobla dla A. Geima i K. Novoselova – 2010**
7. **Zgłoszenie patentowe P 391416 ``Sposób wytwarzania grafenu`` - 2010**
8. **R. R. Nair, ..., W. Strupiński, ..., K. S. Novoselov, A. K. Geim**
Fluorographene: A Two-Dimensional Counterpart of Teflon, Small 2010,
X, No. XX, 1–8, 2010 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim



9. Projekt Europejskiej Fundacji Nauki EuroGRAPHENE – 2010

10. Zaproszenie ITME do europejskiego projektu ``FLAG SHIP`` - 2010

11. Rozpoczęcie badań w ITME nad wzrostem grafenu na folii miedzianej w ramach projektu ZAMAT (koordynator: Instytut Metali Nieżelaznych – Gliwice) – 2010

**12. W.Strupinski, K.Grodecki, A.Wysmolek, R.Stepniewski, T.Szkopek, P.E.Gaskell, A.Grüneis, D.Haberer, R.Bozek, J.Krupka, J.M.Baranowski,
Graphene Epitaxy by Chemical Vapor Deposition on SiC,
Nano Letters 2011, 11, 1786–1791**

13. Podpisanie umowy o współpracy w temacie grafenu z Agencją Rozwoju Przemysłu - 2011



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10 RESEARCH HIGHLIGHTS AND BREAKTHROUGHS 2010-2011

Table 19: Research highlights in graphene 2010-2011

Reserch center	Research
Georgia Tech	June 2011 <ul style="list-style-type: none"> • Researchers devised a simple and quick one-step process based on thermochemical nanolithography (TCNL) for creating nanowires, tuning the electronic properties of reduced graphene oxide on the nanoscale and thereby allowing it to switch from being an insulating material to a conducting material.
IBM	June 2011 <ul style="list-style-type: none"> • IBM produces the first integrated circuit fabricated from wafer-size graphene and demonstrate a broadband frequency mixer operating at frequencies up to 10 gigahertz (10 billion cycles/second).
ITME	April 2011 <ul style="list-style-type: none"> • Researchers discover a new method to produce entire layers of graphene. The new method is based on using epitaxy on silicon carbide in a gaseous, pressurised environment
Stanford University	March 2010 <ul style="list-style-type: none"> • Researchers develop organic lighting-emitting diodes (OLEDs) using graphene as transparent conductors.
Ulsan National Institute of Science and Technology	September 2011 <ul style="list-style-type: none"> • Researchers demonstrate an inexpensive way to obtain graphene in large quantities using edge-functionalized graphite
University of Cambridge	October 2011 <ul style="list-style-type: none"> • Researchers halve the temperature at which high-quality graphene can be grown by adding a small amount of gold (<1%) to a nickel growth film. The gold cuts the chance of nucleation, allowing crystals to grow bigger before they hit one another and form a boundary. Gold also reduces the temperature at which desirable single-atom-thick graphene crystals grow.⁶²
University of Manchester	October 2011 <ul style="list-style-type: none"> • Researchers using boron nitride to isolate graphene from external effects with the intention of building usable graphene transistors and overcoming the stability and quality problems that have hindered graphene for such applications.⁶³
UCLA	October 2011 <ul style="list-style-type: none"> • Researchers develop the fastest graphene transistor to date. Its performance is comparable to the fastest transistors including gallium arsenide and indium phosphide.⁶⁴
UC Santa Barbara	October 2011 <ul style="list-style-type: none"> • A research team led by Kaustav Banerjee, a professor with the Electrical and Computer Engineering department and Director of the Nanoelectronics Research Lab at UCSB has devised a new method of growing high-quality graphene. The new synthesis technique yields high-quality and high-uniformity graphene that can be translated into a scalable process for industry applications.⁶⁵



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<p>INTRODUCTION</p> <ul style="list-style-type: none"> • What is graphene? • Definition • Properties • Commercial types • Comparison with nanoclays and carbon nanotubes • Cost comparison 	<ul style="list-style-type: none"> • Amo GmbH • Angstrom Materials • BASF • Carben Semicon Ltd. • CVD Equipment Corp. • Durham Graphene Science • Fujitsu Laboratories • Graphene Devices Ltd. • Graphene Energy, Inc. • Graphene Frontiers • Graphene Industries Ltd. • Graphene Works, Inc. • Graphenea Nanomaterials • Harbin Mulan Foreign Economic Trade Co. • HRL Laboratories, LLC • Intel Corporation • IBM • Intel • Nanointegris • Nanospense LLC • Nanotek Instruments, Inc. • Quantum Materials Corporation • Samsung Electronics Co., Ltd. • Texas Instruments, Inc. • Vorbeck Materials Corporation • XG Sciences • Xiamen knano graphene Technology Co.,Ltd. • Xolve • XP Nano Material Co. Ltd. 	<p>TABLES AND FIGURES</p> <ul style="list-style-type: none"> • Graphene production in tons, 2010 • Estimated graphene production in tons, 2017 • Graphene production in tons 2008-2017 • Demand for graphene, by market, tons, 2010 • Demand for graphene, by market, tons, 2017 • Demand for graphene, by market, tons, 2010-2017 • Market drivers • Market challenges • Research papers on graphene, 2004-2010 • Patent publications for graphene, 2004-2010 • Graphene producers, production capacities per year, price and end user markets • Commercialization timeline and market demand for graphene in the aerospace market • Commercialization timeline and market demand for graphene in the automotive market • Commercialization timeline and market demand for graphene in the communications market • Commercialization timeline and market demand for graphene in the composites market • Commercialization timeline and market demand for graphene in the electronics and data storage market • Commercialization timeline and market demand for graphene in the energy market • Commercialization timeline and market demand for graphene in the sensors market • Commercialization timeline and market demand for graphene in the thermal management market
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<p>MARKETS AND APPLICATIONS FOR GRAPHENE</p> <ul style="list-style-type: none"> • Market technology roadmaps • Aerospace • Automotive • Coatings and paints • Communications • Composites • Electronics, optoelectronics and data storage • Energy • Sensors 	<p>PROMINENT GRAPHENE RESEARCH CENTERS</p> <ul style="list-style-type: none"> • Brookhaven National Laboratory • Cornell University • Georgia Tech • Institute of Electronic Materials Technology (ITME), Warsaw • Massachusetts Institute of Technology (MIT) • Michigan State University • Princeton University • Rensselaer Polytechnic Institute • Rutgers University • Stanford University • Sungkyunkwan University • University of Manchester • University of Texas, Austin 	<p>No. of pages: 73 Update: October 2011</p>



PROMINENT GRAPHENE RESEARCH CENTERS

- Brookhaven National Laboratory
- Cornell University
- Georgia Tech
- **Institute of Electronic Materials Technology (ITME), Warsaw**
- Massachusetts Institute of Technology (MIT)
- Michigan State University
- Princeton University
- Rensselaer Polytechnic Institute



OBECNIE

GRAFEN epitaksjalny na podłożach SiC

→ **jakość strukturalna**

GRAFEN na foliach metalowych

→ **wielkość powierzchni**

→ **jakość strukturalna**

GRAFEN eksfoliowany

→ **powiększenie skali**

→ **jakość**

→ **funkcjonalizacja**

KOMPOZYTY metal / grafen

KOMPOZYTY tworzywo sztuczne / grafen

POKRYCIA GRAFENEM innych obiektów

→ **elementy optyczne**

→ **ogniwa fotowoltaniczne**



ROLA INSTYTUTU

1. Bilateralna współpraca z przedsiębiorstwami

- zlecenie prac B + R
- wspólne przedsięwzięcia

2. Udział we wspólnych projektach finansowanych z zewnątrz:

- NCBiR
- ARP
- PARP
- UE

3. Kontakt z innymi krajowymi i zagranicznymi placówkami naukowymi

