PhD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
Chemistry and physics of carbon phases	Chemistry N 003	Faculty of Chemistry and Geosciences, Institute of chemistry	Department of Inorganic Chemistry
Student's workload	**Credits**	**Student's workload**	**Credits**
Lectures		Consultations	3
Independent study	7	Seminars	

Course annotation

Virtual and real phases and forms of elemental carbon. Carbon mesophases. Phase diagram of carbon. Conditions of existence of different carbon phases, their thermodynamic stability. Relationship between the structure of a carbon atom and a variety of carbon phases and forms.
Diamond and its crystal lattice. Analogs of the diamond type lattice. Properties of diamond. Comparison of diamond properties with properties of other materials with a diamond-type lattice. Methods of diamond production, regularities of diamond phase formation. Problems and perspectives of diamond synthesis. Thin-layer diamond films.
Variety and properties of fullerenes. Production and use of fullerenes. Types of nanotubes, their properties and methods of production. Research methods when working with nanotubes.
Crystal lattice of graphite. Analogues of layered structure. Various forms of graphite. Synthetic and natural graphite. Use of graphite in modern technologies (composites, carbon ceramics, raw material for other carbon phases and forms, energy storage, lubrication mixtures, electrofunctional materials). Nanotechnology and graphite phases. Graphene, its production, properties, use.
Structure of vitreous carbon. Various types of vitreous carbon. Carbon "alloys". Production of vitreous carbon by pyrolysis of gaseous products and in the coking process. Properties and applications of vitreous carbon.
Carbon composites, their structure, production and application in modern technologies.
Amorphous carbon. Properties of carbon surface. Activated carbon, its production and use. Superactivated carbon, its production and application. Pores in the carbon structure. Other carbon phases. Polycumulene and carbine. Intercalates. Doping of carbon phases: carbides.

Reading list

1. A. Krueger. Carbon materials and nanotechnology. Willey VCH Velag, Weinheim, 2010.
2. Y. Gogotsi. Carbon nanomaterials (Advanced Materials Series) Taylor & Francis, Broken Sound Parkway NW, 2006.
3. L. Dai. Carbon nanotechnology: recent developments in chemistry, physics, materials science and device applications. Elsevier, Amsterdam, 2006.
4. H.O. Pierson. Handbook of carbon, graphite, diamond, and fullerenes: properties, processing, and applications. Noyes Publications, Park Ridge, NJ, 1993.
5. D. Tomanek. Guide through the nanocarbon jungle. Morgan & Claypool Publishers, Oak Drive, San Rafael, CA, 2014.
6. A. Jorio, G. Dresselhaus, M.S. Dresselhaus. Carbon nanotubes (Topics in applied physics series). Springer-Verlag, Berlin Heidelberg, 2008.

The names of consulting teachers	Science degree	Main scientific works published in a scientific field in last 5 year period
Jurgis Barkauskas	Dr. (HP)	1. J. Gaidukevič, J. Barkauskas, A. Malaika, V. Jasulaitienė, M. Kozłowski. Preparation and characterization of basic graphene-based catalysts and their application in biodiesel synthesis. *Applied Surface Science*, 2021, vol. 554, 149588 (13 pp). 2. J. Barkauskas, J. Gaidukevič, G. Niaura. Thermal reduction of graphite oxide in the presence of nitrogen containing dyes. Carbon Letters, 2021, https://doi.org/10.1007/s42823-021-00228-3

		3. A. Popov, R. Aukstakojyte, J. Gaidukevic, V. Lisyte, A. Kausaite-Minkstimiene, J. Barkauskas, and A. Ramanaviciene. Reduced Graphene Oxide and Polyaniline Nanofibers Nanocomposite for the Development of an Amperometric Glucose Biosensor. *Sensors*, 2021, vol. 21, 948 (15 pp) 4. A. Kareiva, A. Beganskiene, J. Senvaitiene, A. Ramanaviciene, R. Vaitkus, J. Barkauskas, A. Ramanavicius. Evaluation of carbon-based nanostructures suitable for the development of black pigments and glazes. *Colloids and Surfaces A*, 2019, vol. 580, 123718 (10 pp). 5. J. Gaidukevič, R. Pauliukaitė, G. Niaura , I. Matulaitienė, O. Opuchovič, A. Radzevič, G. Astromskas, V. Bukauskas, J. Barkauskas. Synthesis of Reduced Graphene Oxide with Adjustable Microstructure Using Regioselective Reduction in the Melt of Boric Acid: Relationship Between Structural Properties and Electrochemical Performance. *Nanomaterials*, 2018, vol 8(11), 889 (17pp). 6. R. Trusovas, G. Niaura, J. Gaidukevič, I. Mališauskaitė, J. Barkauskas. Graphene oxide-dye nanocomposites: effect of molecular structure on the quality of laser-induced graphene. *Nanotechnology*, 2018, vol. 29, 445704 (9pp).

Certified during Doctoral Committee session on September 28th, 2021. Protocol No. 610000-KT-142.
Committee Chairman prof. habil. dr. Aivaras Kareiva