DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Name of subject	Scientific Field	Faculty	Center/Institute/ Department
Optical, Electrical and Sturctural Characterization of Widebandgap Semiconductors (8 ECTS credits)	Physics N 002	Faculty of Physics	Institute of Photonics and Nanotechnology
Student's workload	Hours	Student's workload	Hours
Lectures	6	Consultations	4
Individual study	186	Seminars	4

Course annotation

1. Application of widebandgap semiconductors (SiC, III-nitrides, ZnO, diamonds).
2. Epitaxy of widebandgap semiconductors (MOCVD, MBE, PVT, HVPE).
3. Structural defects and characterization (XRD, TEM, SEM, Raman, cathodoluminescence).
4. Optical properties. Recombination of carriers. Bandstructure. Optical characterization (PL, TRPL, absoption, reflection). Role of dislocations.
5. Electrical properties. Electrical characterization. P-type conductivity. Hall effect, EBIC.
6. Nonlinear optical properties due to free carriers, temperature, electric field. Second harmonic generation. Light induced transient gratings. Modeling of carrier recombination processes.

List of literature

1. Gallium Nitride, II. Eds. J.I. Pankove and T.D. Moustakas, Semicond. and Semimetals, vol 57. Acad. Press, 1999.
2. III-Nitride Semiconductors: electrical, structural, and defect properties, Ed. M. O. Manaresh, Elsevier Science, 2000
3. III-Nitride Semiconductors: Optical Properties, Vol. I (Optoelectronic properties of semiconductors and superlattices) Ed. H. Jiang, Taylor & Francis, 2005
4. Silicon Carbide (Vol.1: Growth, defects, novel applications.Vol 2: Power devices and sensors) Eds. P Friedrichsm T Kimoto, L.Ley, and G. Pensl, Willey VCH, 2010.
5. Zinc Oxide: Bulk, Thin Films and Nanostructures: Processing, Properties, and Applications, Eds C. Jagadish and S. J. Pearton, Elsevier Science, 2006.
6. Wide Bandgap Materials and New Developments, ISBN 81-308-0092-6, Eds. M. Syrjarvi and R.Yakimova, Research Singpost, 2006. Chapter 5.

Consulting teachers	Scientific degree	Pedagogical name	Main scientific works published in a scientific field in last 5 year period
T. Malinauskas	Dr.	Doc.	1. T. Grinys, T. Drunga, K. Badokas, R. Dargis, Andrew Clark, T. Malinauskas "Growth conditions of semi and non-polar GaN on Si with Er2O3 buffer layer", Journal of Alloys and Compounds 725, p. 739- 743 (2017)

			(https://doi.org/10.1016/j.jallcom.2017.07.189). 2. I. Reklaitis, F. Nippert, R. Kudžma, T. Malinauskas, S. Karpov, I. Pietzonka, H. J. Lugauer, M. Strassburg, P. Vitta, R. Tomašiūnas, and A. Hoffmann, "Differential carrier lifetime in InGaN-based light-emitting diodes obtained by small-signal frequency-domain measurements", Journal of Applied Physics, Vol. **121**, p. 035701, 2017(https://doi.org/10.1063/1.4973903). 3. J. Mickevičius, D. Dobrovolskas, T. Malinauskas, M. Kolenda, A. Kadys, G. Tamulaitis "Improvement of luminescence properties of InN by optimization of multistep deposition on sapphire", Thin Solid Films **680**, 89-93 (2019) (https://doi.org/10.1016/j.tsf.2019.04.032). 4. Ž. Podlipskas, J. Jurkevičius, A. Kadys, S. Miasojedovas, T. Malinauskas, R. Aleksiejūnas „The detrimental effect of AlGaN barrier quality on carrier dynamicsin AlGaN/GaN interface" Scientific Reports 9, 17346 (2019) (https://doi.org/10.1038/s41598-019-53732-y). 5. K. Badokas, A. Kadys, J. Mickevicius, I. Ignatjev, M. Skapas, S. Stanionytė, E. Radiunas, G. Juška, T. Malinauskas "Remote epitaxy of GaN via graphene on GaN/sapphire templates" J. Phys. D: Appl. Phys. 54 205103 (2021) (https://doi.org/10.1088/1361-6463/abe500).
Certified during Doctoral Committee session 02/02/2022, protocol No. (7.17 E) 15600-KT-32			
Committee Chairman prof. S. Juršėnas			