

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND TECHNOLOGY**

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: .....  
 DEPARTMENT .....

**COURSE CARD**

**Course name in Polish: Metody krystalizacji i wytwarzania monokryształów**  
**Course name in English: Methods of crystallization and production of monocrystals**  
**Course language Polish /-English\***  
**University-wide general course type\*:**  
 1) specialized course in discipline: .....  
**Subject code: AEQ100153W**

\* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	22		8	
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. General knowledge about thermodynamics, phase changes and property of solid bodies, liquid and gasses,

**COURSE OBJECTIVES**

C1 Acquainting listeners of doctoral studies with techniques of the bulk crystallization and leaving a deposit of crystalline layers (surface crystallization), with particular reference to of semiconductor crystal  
 C2 Getting and consolidating the ability of the information retrieval and personal of introducing them on the open forum, as well as drafting the written study to the set subject

**PROGRAM CONTENTS**

<b>Form of classes – lecture (Lec)</b>		Number of hours
Lec1	Crystallization. Deposition. Epitaxy. Introduction into the subject	2
Lec2	Crystallization. Phase changes. Thermodynamic basic functions. Internal energy. Entropy. Entalpy. Gibbs free energy. Rule of phases	2
Lec3	Limits of the crystalline excellence	1
Lec4	Arrangement homo- and heterogenic. Seeding	1
Lec5	Production of bulk crystal	6

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND TECHNOLOGY**

Lec6	Crystallization from chemical CVD vapours, deposition from physical vapours, the physical transport	1
Lec7	Epitaxy, definition, history, development	1
Lec8	Modes of the growth. Methods of the growth process control. Kinetics of the growth of the epitaxial structures	2
Lec9	Substrate in epitaxy, Problems of the epitaxial crystallization	2
Lec10	Epitaxial techniques	3
Lec11	Examples of material pairs and epitaxial structures – applications	1
	Total hours:	<b>22</b>

<b>Form of classes – foreign language course (Lng)</b>		Number of hours
Lng1		
Lng2		
Lng3		
	Total hours:	

<b>Form of classes – seminar (Sem)</b>		Number of hours
Sem1	Presentations of participants in doctoral studies - subjects set by the lecturer	8
	Total hours	<b>8</b>

<b>Form of classes – mixed forms (mix)</b>		Number of hours
Mix1		
Mix2		
Mix3		
...		
	Total hours	

<b>TEACHING TOOLS USED</b>
N1. Traditional lecture with presentations and discussion N2. Own work – independent search of the literature N3. Own work – of preparing and giving the presentation to the set subject and written drawing up the issue 4. Consultations

<b>ACHIEVED SUBJECT LEARNING OUTCOMES</b>		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge		
Knowledge		
...		

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

Skills		
Skills		
...		
Social competence		
Social competence		
...		

<b>PRIMARY AND SECONDARY LITERATURE</b>
<p><b><u>PRIMARY LITERATURE:</u></b></p> <p>[1] Żmija J. <i>Podstawy teorii wzrostu monokryształów</i>, PWN, Warszawa 1987, [2] Żmija J., <i>Otrzymywanie monokryształów</i>, PWN, Warszawa 1988, [3] Byrappa K., Ohachi T., <i>Crystal Growth Technology</i>, 2003, Williams Andrew Inc./Springer Verlag [4] Mattox D.M., <i>Handbook of Physical Vapor Deposition (PVD) Processing</i>, 1998, Noyes Publications, Westwood, New Jersey, USA [5] Pierson H.O., <i>Handbook of chemical vapor deposition (CVD). Principles, Technology, and Applications</i>, Second Edition, 1999, Noyes Publications, Norwich, New York, USA [6] Byrappa K., Yoshimura M., <i>Handbook of Hydrothermal Technology. A Technology for Crystal Growth and Materials Processing</i>, 2001, Noyes Publications, Park Ridge, New Jersey, USA,</p> <p><b><u>SECONDARY LITERATURE:</u></b></p> <p>[7] Literature on thermodynamics, phase transitions, crystallization, epitaxy</p>
<b>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</b>
Ryszard Korbutowicz ryszard.korbutowicz@pwr.edu.p