

**AGH**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Module name: Thermoelectric materials

Academic year: 2018/2019 Code: CIM-2-307-MN-s ECTS credits: 3

Faculty of: Materials Science and Ceramics

Field of study: Materials Science Specialty: Zaawansowane Materiały Ceramiczne

Study level: Second-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 3

Course homepage: —

Responsible teacher: prof. dr hab. inż. Wojciechowski Krzysztof (wojciech@agh.edu.pl)

Academic teachers: prof. dr hab. inż. Wojciechowski Krzysztof (wojciech@agh.edu.pl)

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Knowledge			
M_W001	Zna podstawowe efekty termoelektryczne		Test
M_W002	Zna zaawansowane metody pomiarów właściwości cieplnych		Test
M_W003	Zna metody charakterystyki właściwości elektrycznych		Test
M_W004	Zna zależność na współczynnik efektywności termoelektrycznej		Test

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes
----------	--	-----------------

		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Knowledge												
M_W001	Zna podstawowe efekty termoelektryczne	-	-	-	-	-	+	-	-	-	-	-
M_W002	Zna zaawansowane metody pomiarów właściwości cieplnych	-	-	-	-	-	+	-	-	-	-	-
M_W003	Zna metody charakterystyki właściwości elektrycznych	-	-	-	-	-	+	-	-	-	-	-
M_W004	Zna zależność na współczynnik efektywności termoelektrycznej	-	-	-	-	-	+	-	-	-	-	-

Module content

Seminar classes

Thermoelectric materials

Fenomenological description of thermoelectric phenomena (Seebeck, Peltier, Thomson effects). basis of non-equilibrium thermodynamics, Onsager's equations, relation between kinetic parameters and transport parameters, generalized Ohm's and Fourier equations, mechanisms of creation of thermoelectric power, diffusive mechanism, phonon drag, magnon drag, phonon and electron equilibrium, influence of external magnetic field, Thermoelectric devices (generators, cooling systems and heat pumps, thermoelectric actuators (thermocouples, heat-flux actuator)s; efficiency of thermoelectric devices, thermoelectric figure of merit ZT, optimisation of materials parameters, optimal band structure, Fermi level, band gap, optimal concentration of current carriers,

Thermoelectric materials; Preparation methods of polycrystalline materials and single crystals, optimization of structural and microstructural parameters - doping, alloying, superlattices, quantum dots; technologies of single-crystals and thermoelectric layers, measurements of thermal parameters: (thermal conductivity: hot plate, guard plate, Lees, Angstrom's, 3-omega, laser-flash methods, specific heat cp measurements) measurements of electrical parameters: (electrical conductivity of layers and bulk materials, Hall carrier concentration, Seebeck coefficient, Peltier coefficient, thermoelectric figure of merit ZT)

Method of calculating the final grade

Średnia ocena z prezentacji i kolokwium

Prerequisites and additional requirements

Prerequisites and additional requirements not specified

Recommended literature and teaching resources

1.A.F. Ioffe, Physics of Semiconductors, Infosearch, London 1960

- 2.B.R. Nag, Electron Transport in Compound Semiconductors, Springer, Berlin 1980
- 3.D.M. Rowe, Thermoelectrics Handbook – Macro to Nano, CRC Taylor & Francis, 2005
- 4.D.M. Rowe, CRC Handbook of Thermoelectrics, CRC Press LLC, London, 1995
- 5.G.S. Nolas, J. Sharp, H.J. Goldsmid, Thermoelectrics – Basic Principles and new Materials Developments, Springer -Verlag, Berlin, 2001
- 6.M.G. Kanatzidis, Chemistry Physics and Materials Science of Thermoelectric Materials, Kluwer Academic, Michigan, 2003
- 7.J. Przyłuski, Materiały termoelektryczne, Wydawnictwa Politechniki Warszawskiej, Warszawa 1983
- 8.S. Filin S. Termoelektryczne urządzenia chłodzące, IPPU Masta, Gdańsk, 2002

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Examination or Final test	2 h
Preparation for classes	40 h
Participation in seminar classes	30 h
Contact hours	5 h
Summary student workload	77 h
Module ECTS credits	3 ECTS