COURSE DESCRIPTION CARD - SYLLABUS

Course name
RAMAN SPECTROSCOPY OF OPTICAL MATERIALS [S5IMAT>SRMO]

Course

Proposed by Discipline
–

Year/Semester
3/6

Level of study
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
4

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

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Lecturers

Prerequisites

Knowledge from the field of experimental physics, solid state physics and spectroscopy.

Course objective

Presentation of the possibilities of using spectroscopic methods, in particular Raman spectroscopy and high-resolution luminescence, to study of single crystalline films of perovskites and garnets obtained by liquid phase epitaxy method.

Course-related learning outcomes

Knowledge:
The PhD student has detailed knowledge of selected topics related to functional materials and their characterization methods (P8S_WG / SzD_W03).

Skills:
The PhD student is able to plan and conduct research leading to the characterization of functional materials; and is able to analyze, develop, and document research results (P8S_UW / SzD_U01).

Social Competencies:
The PhD student understands the need to continually update and expand knowledge and the need to

improve professional and social competencies (P8S_KK / SzD_K02, P8S_KK / SzD_K03).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Presence, discussion, short ending test
Active participation in discussion 0-60%
Short end test 0-40%
3-60%; 3,5-70%; 4-80%; 4,5-90%; 5-95%

Programme content

1. Raman spectroscopy - scattering phenomenon, measurement apparatus.

2. Crystalline perovskite layers deposited on crystalline substrates - optical studies, applications.

3. Crystalline garnet layers deposited on crystalline substrates - optical studies, applications.

Course topics

1. Raman Spectroscopy - Theoretical Description of Light Scattering, Raman Scattering, Selection Rules, and Measurement Equipment Design.

2. Crystalline Perovskite Layers Deposited on Crystalline Substrates - Liquid Phase Epitaxy Method, Morphology of Crystalline Perovskite Layers, Raman Spectroscopy and High-Resolution Luminescence Studies of Cross-Sections of Perovskite Structures.

3. Crystalline Garnet Layers Deposited on Crystalline Substrates - Morphology of Crystalline Garnet Layers, Raman Spectroscopy and High-Resolution Luminescence Studies of Cross-Sections of Garnet Structures.

Teaching methods

Lecture: multimedia presentation, animations, films.

Bibliography

1. Ch. Kittel – Introduction to solid state physics, John Wiley & Sons Inc. 2004.
2. G. Turrell – Infrared and Raman spectra of crystals, Academic Pr., London, 1972.
3. D.L. Rousseau, R.P. Bauman and S.P.S. Porto, Normal mode determination in crystals, Journal of Raman Spectroscopy 10 (1981), 253.
4. K.A. Gschneidner, Jr., J.-C.G. Bunzli, V.K. Pecharsky, Handbook on the Physics and Chemistry of Rare Earths, Elsevier, Amsterdam, 2009.
5. W. Dewo, K. Łuczyńska, Y. Zorenko, V. Gorbenko, K. Drużbicki, T. Runka, „In silico Raman spectroscopy of YAlO3 single-crystalline film", Spectrochim. Acta A 231 (2020) 118111.
6. W. Dewo, V. Gorbenko, Y. Syrotych, Y. Zorenko, T. Runka, Mn-Doped XAlO3 (X = Y, Tb) Single-Crystalline Films Grown onto YAlO3 Substrates: Raman Spectroscopy Study toward Visualization of Mechanical Stress, J. Phys. Chem. C 125 (29) (2021) 16279-16288.
7. W. Dewo, V. Gorbenko, A. Markovskyi, Y. Zorenko, T. Runka, Photoconversion, luminescence and vibrational properties of Mn and Mn, Ce doped Tb3Al5O12 garnet single crystalline films, J. Lumin. 254 (2023) 119481 1-9.
8. A. Markovskyi, P. Radomski, W. Dewo, V. Gorbenko, A. Fedorov, T. Runka, Y. Zorenko, Photoluminescence and Raman spectroscopy of Ce3+ doped Y3Al5O12 single crystalline films grown onto Y3Al5O12 and Lu3Al5O12 substrates, Mat. Res. Bull. 182 (2025) 113141–1-9.
9. K. Bartosiewicz, Y. Smortsova, P. Radomski, M.E. Witkowski, K.J. Drozdowski, M. Yoshino, T. Horiai, D. Szymanski, W. Dewo, J. Zeler, P. Socha, M. Buryi, A. Prokhorov, D. John, J. Volf, T. Runka, T. Pędziński, K. Hauza, V. Jary, Y. Shoji, K. Kamada, E. Zych, W. Drozdowski, A. Yoshikawa, Shaping scintillation and UV-VIS-NIR luminescence properties through synergistic lattice disordered engineering and exciton-mediated energy transfer in Pr3+-doped Lu1.5Y1.5 Al5-xScxO12 (x = 0.0 – 2.0) garnets, J. Mat. Chem. C 13 (2025) 13691-13712.

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,00
Classes requiring direct contact with the teacher	4	0,00
Doctoral student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)	21	1,00