

Universidad de Puerto Rico, Recinto de Río Piedras
Facultad de Ciencias Naturales, Departamento de Física
Course Title: Research Seminar

Suggested Coding: FIS1 6995 -032 Feng (plasma processing of functional nanomaterials)

No. Hours / Credits: 2 hours per week / 2 credit per semester

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Hours: Tuesday, Thursday 4:00-6:00, FB 268

Prerequisites Co-requisites and Other Requirements:

FISI4032 (Methods of Mathematical Physics) or equivalent and permission of the investigator in laboratory or the Director of the Department.

Course Description:

Advanced studies and training in specialized topics of plasma processing of functional nanomaterial and their applications. Focuses of the course are on the discussion of theoretical and experimental methods frontier, discussion of original research results and advanced readings of scientific literature.

Goals:

At the end of the course, each student will have demonstrated an ability to:

- Demonstrate the acquisition of research skills in a particular area of material physics and functional material, including the process of creating new knowledge through the proposition and systematic validation of hypotheses supported by evidence,
- Develop your critical thinking skills about concepts of physics in the context of a particular area of Physics,
- Make a value judgment of scientific publications of a particular area of material physics.
- Integrate fundamental concepts of physics in a particular area of research,
- Exposing discussion open its analysis of own or other investigations,
- Critically analyze the scientific literature of a particular area of material physics.

Content Outline and Time Distribution:

| Weeks | No. Hours | Topics |
|-----------|-----------|--|
| weeks 1-4 | 15 | The first step will consist of 4 weeks of course related to basic concept on material physics and plasma physics Besides learning two topics above, the educational component will also extend into the research laboratory, by providing |

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| | | research experience, and training to students who will be participating in several aspects of the proposed research. Students will “learn the basics” of the material physics, material synthesis technology, and plasma physics. |
| weeks 5-8 | 15 | In this step, following two topics will be demonstrated and taught. (A) plasma sources and plasma physics used in processing of functional materials, (B) Characterization of physics properties using a variety of modern tools: STEM, Raman, FTIR, Ellipsometry, XPS, X-ray diffraction. |
| weeks 9-12 | 15 | In this period, the focus of the course will be on the functional nanomaterial and their applications on gas sensor, photodetector and other electronic devices. Gas sensors: The electric behavior of functional material, its feasibility as a gas sensing material and how these are affected by plasma treatment. Photodetectors: Photodetectors by exploring new functional material produced by laser plasma deposition technique. Effect of plasma treatment on the increase of wavelength cut-off and sensitivity |

Instructional Strategies:

The instructional method of the seminar is based on the discussion of frontier functional material research in a particular area of sensing material and their applications for gas sensors, UV detectors, diodes, etc. that are closely related to our current research project supported by DoD Army research office.

Minimum resources available: audiovisual and conference room projectors.

Evaluation Strategies:

Attendance and active participation of students in the discussion are essential (25%). Each student makes a presentation of the results of research in which it participates and discusses the relevant scientific literature (50%). the increase achieved in the level of proficiency in the particular area of research in physics (25%) is evaluated.

Rating system: approved or not approved

Suggested Textbook: Electronic thin film science for electrical engineers and materials scientists

by Tu King-Ning; James W Mayer; Leonard C Feldman, New York, N.Y. : Macmillan, 1996

Bibliography

1. Plasma Processing of Nanomaterials (Nanomaterials and their Applications) by R. Mohan Sankaran, Amazon Digital Services LLC, ISBN-13: 978-1439866764, 2016
2. Scanning probe microscopy: characterization, nanofabrication and device application of fictional material 2005 by Paula Maria Vilarinho, Yossi Rosenwaks, Angus Kingon, ISBN 9781402030192 • 9781402030178, DOI 10.1007/1-4020-3019-3
3. Classical Electrodynamics, John David Jackson, Wiley, 1998
4. Quantum Mechanics, Eugen Merzbacher, Wiley, 1997
5. Solid State Physics, Gerald Burns, Academic Press, 1985

Recommended Internet resources:

1. Advanced functional material ([http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1616-3028](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1616-3028))
2. ACS nano (<http://pubs.acs.org/journal/ancac3>),
3. Nanoscale (<http://www.rsc.org/journals-books-databases/about-journals/nanoscale/>)
4. Applied Physics Letters (<http://apl.aip.org/apl/>),
5. Journal of Applied Physics (<http://jap.aip.org/>),
6. Sensors & Actuators: B. Chemical (<http://www.journals.elsevier.com/sensors-and-actuators-b-chemical/>),
7. Nature (<http://www.nature.com/index.html>),
8. Science (<http://www.sciencemag.org/>)

Reviews

1. Anup Kumar Keshri and Arvind Agarwal, Plasma Processing of Nanomaterials for Functional Applications—A Review, *Nanoscience and Nanotechnology Letters*, 4, 228–250 (2012)
2. Ali Aldalbahi, Andrew Feng Zhou, Susheng Tan, and Peter Feng, Fabrication, Characterization and Application of 2D Boron Nitride Nanosheets Prepared by Pulsed Laser Plasma Deposition, *Reviews in Nanoscience and Nanotechnology*, 5, 1–14(2016)
3. Gasparotto A, Barreca D, Bekermann D, Devi A, Fischer RA, Maccato C, Tondello E. Plasma processing of nanomaterials: emerging technologies for sensing and energy applications, *J. Nanosci. Nanotechnol.* 11(9), 8206-13. (2011)

Rights of Students with Disabilities:

The University of Puerto Rico complies with state and federal laws and regulations concerning discrimination, including Law 51 of the Commonwealth of Puerto Rico and the federal law known as the 1990 Americans with Disabilities Act (ADA). Students who receive vocational rehabilitation services or require any assistance should inform the teacher (a) in charge of the course about this situation for reasonable accommodation to have equal access to education and services offered by the University of Puerto Rico accordance with the recommendations Affairs Office for Persons with Disabilities (OAPI) the Dean of Students.

Academic integrity:

La Universidad de Puerto Rico promueve los más altos estándares de integridad académica y científica. El artículo 6.2 del Reglamento General de Estudiantes de la UPR (Certificación Núm. 13, 2009-2010, de la Junta de Síndicos) establece que "la deshonestidad académica incluye, pero no se limita a: acciones fraudulentas, la obtención de notas o grados académicos valiéndose de falsas o fraudulentas simulaciones, copiar total o parcialmente la labor académica de otra persona, plagiar total o parcialmente el trabajo de otra persona, copiar total o parcialmente las respuestas de otra persona a las preguntas de un examen, haciendo o consiguiendo que otro tome en su nombre cualquier prueba o examen oral o escrito, así como la ayuda o facilitación para que otra persona incurra en la referida conducta". Cualquiera de estas acciones estará sujeta a sanciones disciplinarias en conformidad con el procedimiento disciplinario establecido en el Reglamento General de Estudiantes de la UPR vigente.