

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

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

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

Profesor: peter Feng  
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Hours: Tuesday, Thursday 4:00-6:00, FB 127

**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

		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:**

UPR complies with all Federal and State Laws and regulations regarding discrimination, including the Americans with Disabilities Act 1990 (ADA) and the Commonwealth of Puerto Rico Law 51. Students receiving services through Rehabilitation Vocational must contact the professor at the beginning of the semester in order to plan for a reasonable accommodation and any required support equipment according to the recommendations given by the Oficina de Asuntos para Personas con Impedimentos (OAPI) of the Dean of Students. Likewise, students with special need that require some type of accommodation must contact the professor at the beginning of the semester.

### **REGULATION ON DISCRIMINATION BY SEX AND GENDER IN THE FORM OF SEXUAL VIOLENCE:**

"The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy

Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, must turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or a formal complaint. "

**REASONABLE ACCOMMODATION:**

The University of Puerto Rico complies with all state and federal laws and regulations related to discrimination, including "The American Disabilities Act" (ADA law) and Law #51 from the Puerto Rico Commonwealth (Estado Libre Asociado de Puerto Rico). Every student has the right to request and receive reasonable accommodation and Vocational Rehabilitation Services (VRS). Those students with special needs that require some type of particular assistance or accommodation shall explicitly communicate it directly to the professor. Students who are receiving VRS services shall communicate it to the professor at the beginning of the semester so that appropriate planning and the necessary equipment may be requested according to the Disabilities Persons Affairs Office (Oficina de Servicios a Estudiantes con Impedimentos –OSEI) from the Students' Deanship office. Any other student requiring assistance or special accommodation shall also communicate directly with the professor. Reasonable accommodations requests or services DO NOT exempt the student from complying and fulfilling academic and course related requirements and responsibilities.

**ACADEMIC INTEGRITY:**

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.

To ensure user data integrity and security, hybrid and distance education courses are offered through the institutional learning management system, which employs secure connection and authentication protocols. The system authenticates the users' identity with the username and password of their institutional accounts. Users are responsible for keeping their password secure and not sharing with others.