

Chemistry 461 or 579: Concepts in Nanochemistry

Location (ARC-105)
Monday & Thursday 10:20-11:40 am

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COURSE DESCRIPTION AND GOALS: The emergence of nanoscience/nanotechnology in the past decades has been accompanied by the parallel development of the chemistry of nanomaterials (“*Nanoscience*”). The fundamental concept of this discipline is the hypothesis that with advanced knowledge of chemical scientists can design, synthesize, and functional nanomaterials with unique physicochemical properties and build up self-assembled nanostructures from the molecular scale to the nanoscale. For this purpose, students should learn a broader skill-set and knowledge base for chemistry and its related applications. For example, it is not enough to know about the synthesis/fabrication and functionalization of nanomaterials such as graphene and magnetic nanoparticles. It is also necessary to know how these materials will be utilized, such as for biosensing and bioimaging applications, respectively. The intended applications heavily influence the desired physicochemical properties needed in the system, which further affects the synthetic and functionalization protocols for these materials. Therefore, the main goal of this course is to give students (*junior, senior undergraduates, or graduate students*) an in-depth/up-to-date acquaintance with the emerging interdisciplinary research field of nanochemistry. The course will also offer a comprehensive overview of special topics, such as nanomedicine, molecular imaging, drug/gene delivery, and nanobio devices and systems, which all represent major applications in the field of nanochemistry.

Module 1: Introduction; course outline, nanoscience, nanomaterials, conjugation chemistry, and applications

Module 2: Design and synthesis of inorganic/organic nanomaterials; fluorescent, magnetic, novel metal nanoparticles

Module 3: 0-, 1-, 2-, and 3D dimensional nanomaterials (including graphene and carbon nanomaterials)

Module 4: Biomimetic Nanochemistry, High-throughput Screening (HTS) and High-Content Analysis (HCA), Large-scale synthesis

Module 5: 3D and 4D (Bio) Printing with Nanomaterials/Biomaterials

Module 6: Special topics in nanochemistry (focusing on Bio and Nanomedicine)

Guest Lectures:

- Dr. Kim-phuong Le and Cemile Bektaş (Biomaterials): 3D/4D micro/nano-manufacturing (bioprinting) technologies and applications
- Prof. Li Cai (BME/Neuroscience): Stem Cell Biology and Tissue Engineering
- Prof. Kelvin Kwan (Neuroscience): Molecular basis of neural cell regeneration, Super-resolution Microscopy
- Prof. Peng Jiang (Cell Biology and Neuroscience): Organoids, Spheroids, & 3D Cell Culture
- Prof. James E. Gervasoni M.D./PH.D. (Cancer Nanomedicine): Nanotechnologies in Pancreatic Cancer Therapy; Cancer-Diagnosis and Treatment
- Dr. SangAh Yi (Pharmacy): Metabolic Diseases (Diabetes and Obesity) and Brain/Cardiac Organoids

PREREQUISITES: Undergraduates who took general/AP chemistry, or special permission of the instructor

ASSIGNMENT AND GRADING: (*No Written Exams*) Grades will be based on the following:

1. Attendance: *150 pts.*
2. 10 Min Presentation: *150 pts.*
3. **Mid-Term Papers:** Term paper showing a critical understanding of a set of topics. Due dates will be announced later. *300 pts.*
4. **Final-Term (Project) Paper and Presentation:** One 5-page paper proposing a new idea/project based upon the knowledge and topics that will be covered during this class and a 15 min presentation on the aforementioned proposal. *400 pts.*
5. **Total:** *1000 pts.*

READING TEXTBOOK AND REFERENCES:

Ludovico Cademartiri; Geoffrey A Ozin (2009), Concepts of Nanochemistry, Weinheim : Wiley-VCH
Reading materials and lecture notes will be posted online. (no need to purchase the textbook)

Reference Textbooks and References:

1. Geoffrey A Ozin; André C Arsenault; Ludovico Cademartiri; (2009), **Nanochemistry : a chemical approach to nanomaterials** Royal Society of Chemistry (Great Britain)
2. Greg T. Hermanson (1996), **Bioconjugate Techniques** : Academic Press
3. Recent published Nanomedicine papers (will be selected by the professor)