Chemistry 461 or 579: Concepts in Nanochemistry

Location (WL 231)
Monday & Wednesday 6:40-8:00 pm

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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 (“Nanochemistry”). The fundamental concept of this discipline is the hypothesis that with an advanced knowledge of chemistry scientists are able to design, synthesize, and functional nanomaterials having unique physiochemical properties, and to build up self-assembled nanostructures from the molecular scale to the nanoscale. For this purpose, it is necessary that students 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 used, such as for biosensing and bioimaging applications, respectively. The intended applications heavily influence the desired physiochemical properties needed in the system, which of course influences 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. Special emphasis will be placed on design, synthesis and conjugation of inorganic and organic nanomaterials. The course will also offer a comprehensive overview of special topics, such as nanomedicine, molecular imaging, drug delivery, and nano-bio devices and systems, which all represent major applications in the field of nanochemistry.

Each student will be required to select one application topic (in module 6) and lead a discussion session.

Module 1: Introduction; course outline, nanoscience, nanomaterials, conjugation chemistry, and applications
Module 2: Design and synthesis of inorganic nanomaterials; fluorescent, magnetic, novel metal nanoparticles
Module 3: Design and synthesis of organic nanomaterials (focusing on Graphene/2D nanomaterials)
Module 4: 0-, 1-, and 2-dimensional nanomaterials nanowires, nanorods, nanoporous materials (including Graphene)
Module 5: Bioconjugation chemistry
Module 6: Special topics in nanochemistry (focusing on Bio and Materials)

Guest Lectures:
- Prof. Howon Lee (Mechanical Eng.): 3D micro/nano manufacturing (printing) technologies and applications
- Prof. Sagar Khare (CCB/Proteomics): Synthetic Biology, Protein Engineering
- Prof. SangHuK Lee (Physics/Proteomics): Super-resolution Microscopy and its applications
- Prof. Kelvin Kwan (Neuroscience): Molecular basis of neural cell regeneration
- Prof. Hilton Karplan (Biomaterials, MD): Tissue-Engineering and Stem Cell Transplantation

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

ASSIGNMENT AND GRADING: Grades will be based on the following:
1. Attendance: 150 pts.
2. 7 Min Presentation: 150 pts.
Concepts of Nanochemistry (Syllabus)

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.

MAIN TEXTBOOK AND REFERENCES:
Ludovico Cademartiri; Geoffrey A Ozin (2009), Concepts of Nanochemistry, Weinheim : Wiley-VCH
Reading materials and lecture notes will be posted online.

Reference Textbooks:
1. Geoffrey A Ozin; André C Arsenault; Ludovico Cademartiri; (2009), Nanochemistry : a chemical approach to nanomaterials Royal Society of Chemistry (Great Britain)


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