Nanotechnology And Its Applications In Biotechnology and Food
(16:400:613)

Faculty:
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Course Description:

Advances in nanotechnology now allow the creation and utilization of materials, devices, and systems, at the atomic, molecular, and supramolecular levels in the length scales of 1-100 nm, with fundamental new properties and functions. The developments in nanotechnology will have an impact on food science and the design of the next generation's food systems. This course will provide students the opportunity to learn and appreciate the most recent research progresses in the area of new technology. This course will be focused on the basic concepts, investigation tools, and fundamental issues of nanotechnology, with special emphasis on the applications of nanotechnology in the agricultural and food systems, as well as the healthcare and food safety related areas. The uniqueness of this course lies in the fact that most of the materials talked come from the research articles published during the past five years, and many key concepts in nanotechnology, such as self-assembly, scanning probe microscopy, organic/inorganic nanocomposites, DNA and protein chips will be addressed in this course.

Learning Outcomes:

Students are expected to understand the basic concepts, investigation tools, and fundamental issues of nanotechnology. To understand self-assembly, scanning probe microscopy, organic/inorganic nanocomposites, DNA and protein chips.

Learning Assessments:

Course content is assessed through two written exams, an oral presentation and a written proposal/critical essay, with the emphasis on critical thinking and problem solving. Grades from the two exams will count for 60% of the final grade, while the written proposal/critical essay/oral presentation will count for rest of the 40% of the final grade.

Topics [week(s)]

- Introduction of Food Nanotechnology
- Scanning Probe Microscopy
- Electron Microscopy and Scattering Techniques
- Assembly of Food Nanostructures (Hydrogels vs. Organogels)
- Emulsion Technologies
- Protein (including Bioactive Peptides)/Polysaccharide Complexes

- Electrospinning of Biomaterials
- Probes for Biological Imaging
- Nanocomposites for Packaging Applications
- Surface Immobilization and Functionalization
- Nanotechnology for pathogen detection and intervention
- Student Presentation

Reading Materials

(1) "Nanotechnology in the Food, Beverage and Nutraceutical Industries", Huang, Q. R. edited, Woodhead Publishing: Cambridge, UK, 2012.
(2) "Micro/Nano Encapsulation of Active Food Ingredients", Huang, Q. R., Given, P., and Qian, M. edited, ACS Symposium Series, 1007, Oxford University Press: Washington, DC, 2009.
(3) The instructor will also provide handouts from review articles and book chapters for related topics.

Elements of the Research Proposal

The research proposal will be a major component of this course. The purpose of the project is to give the students the opportunity to explore exciting areas of food nanotechnology, and to practice generating new research ideas. The proposal will include both written and oral components. The examples of topic areas will include, but are not limited to:

(1) Design of novel functional food ingredients using nanoemulsions, self-emulsified delivery systems, nanodispersions, and polymer micelles;
(2) Pickering emulsions;
(3) Absorption, digestion, bioavailability, and toxicity of nanostructured food ingredients;
(4) Novel anti-microbial delivery systems to address antimicrobial resistence;
(5) Formation of nanostructured food biopolymers using electrospinning technology;
(6) Design of food protein nanotubes/nanofibers;
(7) "Smart" biodegradable nanocomposites;
(8) Core-shell nanoparticles-based food/drug delivery systems;
(9) Sensor-on-packaging technology, etc.