

The University of Western Ontario
Chemistry 9547S, Winter 2026
Surface Chemistry of Nanoparticles

Instructor:

Name: Dr. Lijia Liu

E-mail: lijia.liu@uwo.ca

Office: ChB 1A

Description:

This graduate-level course explores the fundamental principles of surface and interface chemistry and applies them to the colloidal nanoparticle systems. Emphasis is placed on understanding the nanoscale surface phenomena that govern particle interactions, stability, and functional behavior in solid-gas, solid-liquid, and solid-solid environments.

Topics include van der Waals and electrostatic forces between particles, the electric double layer, zeta potential, and the combined effects of these forces on colloidal stability. The course also examines key concepts at the liquid–solid interface, such as surface tension, adsorption phenomena, and ligand binding mechanisms specific to nanoparticles.

Real-world examples involving commonly studied nanoparticle systems will also be introduced, including metal (e.g. Au, Pt), metal oxides (e.g. SiO₂, Al₂O₃), and quantum dots. By the end of the course, students will develop a mechanistic understanding of how surface and interfacial properties influence nanoparticle synthesis, processing, and application.

Lectures days:

Days: Wednesdays and Fridays, First day of class: January 7, 2026

Time: 10:00 am – 11:30 am

Learning outcome:

Upon completion of this course, students will be able to

- Gain fundamental understanding on van der Waals force and how it related to particle stability;
- Realize the importance of surface structure characterization to nanoparticle and thin film fabrication and processing;
- Rationalize the fundamental reasons behind the unique size- and shape-dependent properties of nanoparticles;
- Predict the stability of nanoparticles based on their surface structure;
- Propose general approaches to modify nanoparticles surfaces to achieve the desired functionalities.

Topics:

- Introduction
 - ♦ Fundamentals of surface properties
 - ♦ Surface science at the nanoscale
- Interparticle forces
 - ♦ Fundamentals of van der Waals force
 - ♦ VDW force applies to large objects
- Interaction between charged particles
 - ♦ Fundamentals of electric double layer forces
 - ♦ Zeta potential
 - ♦ Overall stability (VDW + EDL)
- Liquid-solid interface
 - ♦ Surface tension and drying
 - ♦ Surface adsorption
 - ♦ Ligand binding types
- Examples of nanoparticle surfaces
 - ♦ Metal nanoparticles
 - ♦ Metal oxide nanoparticles
 - ♦ Quantum dots

Resources:

No textbook required.

Lecture notes and handouts will be provided as the course proceeds.

Evaluation

Assignments (2): 50%

Presentation: 30%

In-person assessment: 20%

Course attendance and missed/late assignments

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed.

Notes on Academic Honesty

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Health and Wellness

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. For example, to support physical activity, all students, as part of their registration, receive membership in Western's Campus Recreation Centre.

Numerous cultural events are offered throughout the year. For example, please check out the Faculty of Music web page <http://www.music.uwo.ca/>, and our own McIntosh Gallery <http://www.mcintoshgallery.ca/>. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>. Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html.