Department of Materials Science and Engineering Seminar Series 2026

PROGRAMMABLE CARBON NANOMATERIAL BIOINTERFACES: FROM PASSIVE COATINGS TO BIOACTIVE MEMBRANES AND BIOFUNCTIONAL DEVICES

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Date and time: 20th November 2026 (Friday), 9:00 am

Venue: EA-06-04

Abstract

The performance of a biomedical material is decided at its interface with the biological environment. Carbon-based materials, spanning graphene derivatives and amorphous carbon, offer tunable surface chemistry, molecular transport and electrical properties within a single family. This thesis treats the carbon biointerface as a designable variable, organized along a continuum of programmability. Few-layer graphene and amorphous carbon coatings grown directly on nitinol show that the sp^3/sp^2 ratio set during synthesis governs corrosion protection and vascular-cell response. Graphene oxide membranes with a confined shape-memory polymer respond autonomously to inflammation-relevant temperatures, gating oxygen transport, accelerating antibacterial release and capturing glucose. Reduced graphene oxide–polyelectrolyte devices convert low-voltage electrical inputs into ionic stimuli that modulate intracellular Ca^{2+} signaling. Together, these systems relocate control over the biointerface from synthesis, to the physiological environment, to an external operator.

Biography

Zhang Yixin received a B.Eng. in Materials Science and Engineering from Northwestern Polytechnical University, China, and an M.Sc. in the same field from the National University of Singapore (NUS). Yixin is currently a Ph.D. candidate in the Department of Materials Science and Engineering at NUS, supervised by A/Prof Daria Andreeva-Baeumler and Adjunct A/Prof Vitaly Sorokin, working on programmable carbon nanomaterial biointerfaces.

Please join us!

Host: Asst Prof Jing Yan