הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Tuesday, June 16th, 2026 at 13:00

Room 5

Studying Automated Approaches in Design and Synthesis of Nanoparticles for RNA Delivery

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PhD Seminar

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The clinical success of RNA-based therapeutics is currently limited by the technical complexity of nanoparticle synthesis and the high barrier to entry for lab automation in research and education. While Lipid Nanoparticles (LNPs) remain the gold standard, there is a critical need for both novel, biocompatible carrier materials and accessible digital frameworks that allow non-expert researchers to utilize high-throughput robotic systems. Initially, training in standard LNP technologies was adapted into a digitized workflow using a Tecan automated liquid handler. Central to the experimental work was the development of a novel class of nanoparticles derived from bile pigments. It was discovered that the lipid tail modification of bilirubin (Bil-C12) enables high-affinity binding to nucleic acids. Using multiple screens performed by the liquid handler and AI-assisted chemistry database applications, we characterized the binding dynamics, revealing that bilirubin-lipid conjugates bind RNA through a combination of hydrogen, hydrophobic, and pi-stacking interactions. To further bridge the gap between hands-on methods and robotic automation, we developed an AI-driven protocol translator, which converts standard laboratory protocols into machine-executable command lists, removing the requirement for traditional programming expertise. The practical

utility of this automated framework was validated through "Robiochemistry," a remote-access educational course. This initiative enabled students across high-ranking Asian universities to remotely operate the liquid handling system, successfully designing, synthesizing and analyzing LNPs via digitized scripts, proving that automation can facilitate global scientific collaboration. By integrating AI-assisted tools, automated synthesis, and remote education, this research demonstrates how available digital resources can simplify complex science and accelerate the development of next-generation RNA delivery systems.