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

Monday, February 16th, 2026 at 13:30

Room 6

Nanostructure and Nanostructure-properties Relations in Polyelectrolyte Complexes Systems

Sapir Rappoport

PhD Final Seminar

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Polyelectrolytes are charged macromolecules that are responsive to pH and ionic strength in solution. This property makes them attractive for therapeutic applications, particularly as non-viral gene delivery systems and as drug delivery carriers. Through electrostatic interactions, oppositely charged polyelectrolytes spontaneously form polyelectrolyte complexes, which can protect sensitive cargo such as DNA, enhance stability in biological environments, and enable controlled interactions with cellular membranes.

This lecture focuses on two model systems that demonstrate aspects of polyelectrolyte-based complexes. The first part addresses complexes formed between the cationic copolymer quaternized poly(2-(dimethylamino ethyl methacrylate)-b-poly(oligo(ethyleneglycol) methyl ether methacrylate) (QPDMAEMA-b-POEGMA) and DNA, emphasizing their structure at different charge ratio and stability. The second part examines amphiphilic interpolyelectrolyte complexes composed of the cationic poly(diallyldimethylammonium chloride) (PDADMAC) with the anionic poly(acrylic acid) (PAA) or hydrophobically modified PAA, and their interactions with dioleoylphosphatidylcholine (DOPC) lipid vesicles, as a model cell membrane. Particular attention is given to the effects of hydrophobic modification and pH on the aggregation behavior and to the dynamics of interactions with DOPC vesicles.

We investigated the structural and dynamic properties of these systems by cryogenic transmission electron microscopy, including a novel time-resolved on-the-grid mixing approach that captures short-lived intermediate interaction states. Complementary quantitative characterization is provided by small-angle x-ray scattering, providing comprehensive understanding of structure–function relations in polyelectrolyte-based nanocarriers.

Refreshments will be served at 13:15.