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, October 20th, 2025, at 13:30

Room 1

Designing Advanced Physically Crosslinked Hydrogels

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PhD Seminar

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Physically crosslinked hydrogels are soft materials formed by non-covalent interactions such as hydrogen bonding, hydrophobic forces, and electrostatic interactions. Their reversible bonds impart shear-thinning, self-healing, and adaptability, making them attractive for biomedical uses. The 3D network architecture and composition of hydrogels significantly influence their mechanical and physical properties; therefore, understanding them is essential for designing optimized hydrogel-based biomaterials. This talk will be focused on three directions. One direction focused on combining konjac glucomannan (KGM) with crosslinked kappa-carrageenan nanogels (KCAR-NGs). The network, stabilized by hydrogen bonds and entanglements, displayed shear-thinning, self-healing, and dissolution synchronized with swelling. Varying nanogel concentration, temperature, or potassium ions altered swelling and dissolution kinetics and tuned mechanical properties. This formulation emerges as a promising sacrificial material, coupling mechanical stability with rapid, mild dissolution under physiological conditions. Another direction explored the impact of network architecture by comparing a classic hydrogel, formed through direct polysaccharide interactions, with a nanogel junction network where KCAR-NGs bridged KGM chains. Both had comparable crosslinking densities, but the classic network showed superior tensile strength, swelling resistance, and dissolution stability. In contrast, the nanogel junction network exhibited higher permeability, faster dissolution, and a more open structure, advantageous where transport or degradation is required. A third avenue investigated yeast protein (YP)–polysaccharide blends as sustainable bioinks. YP was combined with alginate (Alg), xanthan gum (XG), or both. The triple blend (8% YP, 2% Alg, 0.5% XG) merged advantages: Alg enabled Ca^{2+} crosslinking and XG enhanced rheology. The bioink displayed high printability, structural fidelity, compressive stability up to 70%, and recovery, enabling tissue and food printing applications. Together, these studies show how physical crosslinking and tailored network architectures open access to unconventional hydrogel design opportunities.

Refreshments will be served at 13:15.