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, August 21st, 2023 at 13:30
Room 1

Triggered release device based on polydopamine's photothermal ability

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MSc Seminar

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A major challenge in agriculture these days is pesticide malpractice including overuse, accidental spillages, improper equipment use, and more. "Triggered release" is a potential solution to this problem, in which substances are released by interrupting the integrity of the carrying device, induced by external stimulation. This research aims to explore the feasibility of developing a new light triggered release encapsulating shell composed of shellac embedded with polydopamine nanoparticles (PDA NPs) with a trigger release mechanism based on PDA's capacity to absorb photons and convert them to thermal energy, a phenomenon often referred to as "the photothermal effect". Thus, upon light irradiation the PDA NPs can induce cavities in the encapsulated shell to promote content release. The first step in this study was to synthesize PDA nanoparticles and characterize them through dynamic light scattering (DLS), UV-Vis spectroscopy, while two types of modified shellac films containing PDA nanoparticles were fabricated and characterized by light microscopy, a high resolution scanning electron microscope (HR-SEM), fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), puncture strength tests, and irradiation tests. The results show that PDA NPs with an average diameter of 444 nm were distributed evenly throughout the composite film’s volume. In the presence of NPs, the mechanical properties of the films were not significantly affected. FTIR analysis revealed no interaction between the different modified shellac and PDA NPs but detected oxidation products during irradiation tests. Both types of composite films based on shellac modification and a low percentage of PDA NPs ruptured rapidly upon irradiation but the modifier type and PDA NP concentration affected the thermal properties. Compounding shellac with a higher molecular weight modification or larger NP concentration shifted its melting temperature to lower values, which subsequently diminished its resistance to heat and enhanced its sensitivity to light irradiation. Thermal degradation mainly occurs in areas directly irradiated with green light, where heat is generated. In addition to potentially mitigating pesticide malpractice, the suggested light-triggered release encapsulating device might also lend itself to other applications, which could be explored further.

Refreshments will be served at 13:15