Department of Chemistry
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Bar-Ilan University

המחלקה לכימיה
הפקולטה למדעים מדויקים
אוניברסיטת בר־אילן

The Department of Chemistry Weekly Seminar

Monday 6/12/21 12:00pm (refreshments 11:45am)

Highly tunable Pickering emulsion/polymer systems: from colloids to functional surfaces

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Pickering emulsions are stabilized by nanoparticles (NPs) that are self-assembled at the oil-water interface and act as physical barriers. Pickering emulsions come in the form of oil-in-water (o/w) or inverse emulsions. Inorganic NPs such as silica, titania, and NPs from natural origin such as virus-like particles (VLPs), can act as Pickering stabilizers. At the interface, the wettability of the particles determines their localization in the water and the oil phase. This study presents a novel highly tunable platform, based on incorporated polymers in Pickering emulsions. The polymer component is dissolved in the dispersed or continuous phase or is covalently conjugated to the Pickering stabilizer. Silica and titania nanoparticles were used as stabilizers and functionalized with different polysiloxane oligomers to tune their surface properties. Natural stabilizers including VLPs were also used. Different polymers were dissolved in the dispersed or the continuous phase of the emulsions including polydimethylsiloxane (PDMS) and polyacrylate. Water-in-toluene/xylene emulsions stabilized by hydrophobic silica, with PDMS dissolved in the contentious phase were formulated. The application of the emulsions on polypropylene substrates followed by drying (emulsion templating) resulted in the formation of surfaces with a combination of micron-scale and nanoscale roughness, which endowed them with the property of superhydrophobicity. The antibiofilm properties of the resulting superhydrophobic coatings were investigated. Our in-vitro antibiofilm trials with E. coli exhibited up to an 83% reduction of the biofilm accumulation. In addition, toluene in water Pickering emulsion stabilized by silica particles which were co-functionalized by two trialkoxysilanes: a hydrophilic one ((3-aminopropyl) triethoxysilane) and a hydropohbic one (dodecyltriethoxysilane), formed multi-walled carbon nanotubes/silica/Polysiloxane hybrid colloidosomes with tunable electrical conductivity. To the best of our knowledge, this is the first time that MWNT/silica hollow shells have been generated using a Pickering emulsion templating approach. Next, eco-friendly Pickering emulsions were formulated based on paraffine-in-water emulsions stabilized by silica or titania

nanoparticles functionalized with (3-Aminopropyl) triethoxysilane. The controllable droplet size along with the high colloidal stability of the Pickering emulsions enabled the individual compartmentalization of fungal biopesticides (Metarhizium brunneum) by simple mechanical mixing. The Pickering emulsions with the individually compartmentalized biopesticides exhibited significantly higher pest control activity against Spodoptera littoralis larvae than the controls. The titania-based emulsions successfully protected the individually compartmentalized cells from UV radiation. The stabilization of the same paraffin-in-water emulsions by plantbased VLPs resulted in a fully biocompatible emulsion. A new two-mode approach for epitope presentation of SARS-CoV-2 was then developed based on these fully biocompatible emulsions. Covalent attachment of SARSCoV-2 S1-peptide epitopes to the VLPs surface and the subsequent assembly of VLP/epitope conjugates at the oil/water interface of the paraffin-in-water emulsions enabled to significantly enhance the SARS-CoV-2 epitope presentation intensity. Our in-vivo assay in mice showed that the αSARS-CoV-2-S1 IgG titers of the mouse antisera taken from mice that were exposed to the studied emulsions were an order of magnitude higher compared to epitopes administered with an adjuvant. These results confirmed the effectivity of the new formulation. This novel VLP-based Pickering-emulsion-platform is a fully synthetic approach that can be readily applied for vaccine development to a wide range of pathogenic epitopes.

Location: Seminar room 112

Looking forward to seeing you!