Title:	Optically Active Nanomaterials in Food and Agriculture Applications
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Abstract:	In traditional agriculture sun light play an important role in the key activities like production, protection, processing and sensing. First, the photosynthesis is the key process for the production, which solely depend on light; while, in protection light trap play an important role in the pest control; finally, for the processing of the yield, globally the harvesting time is scheduled in the maximum light hours season for the easy drying and storage. Hence with this inspiration here an attempt has been made to use photo active nanomaterials to do some additional job in controlled fashion for the advanced agriculture application. In this context we have explored the application of optically active nanomaterial for the protection, processing and sensing. Mushrooms are rich in ergosterol, a precursor of ergocalciferol, which is a type of vitamin D 2 . The conversion of ergosterol to ergocalciferol takes place in the presence of UV radiation by the cleavage of the “B-ring” in the ergosterol. As the UV radiation cannot penetrate deep into the tissue, only minimal increase occurs in sunlight. In this study, upconversion nanoparticles with the property to convert deep-penetrating near-infrared radiation to UV radiation have been cast into a disk to use sunlight and emit UV radiation for vitamin D conversion. An engineered upconversion nanoparticle (UCNPs) disk with maximum particles and limited clusters demonstrates ~2.5 times enhanced vitamin D 2 conversion. The indiscriminate use of pesticides leads to irreparable damage to the ecosystem, which motivates for sustainable alternatives like pheromone-assisted pest management. The tomato pinworm Tuta absoluta is a major threat to tomato cultivation. Moreover, its green management technology uses a pheromone trap that has a short field life. To overcome this problem, a pheromone composite with graphene oxide (GO) and amine-modified graphene oxide (AGO) that can extend the diffusion path has been developed. The composite stimulates an effective electrophysiological response in the antenna, which results in trapping of a significantly higher number of insects as compared to the commercial septa, thus qualifying it for field evaluation. Compared to AGO, the GO composite has pheromones assembled into a multilayer, which increases the pheromone diffusion path. This in turn resulted in the extension of the pheromone life that proportionally increased the pest trapped. Further the nano-edifice has been tested for photo triggered controlled pheromone release and pest collection. This technique will be beneficial to farmers as they have longer field efficacy to keep the pest damage low in an environmentally friendly manner. viLycopene, a natural colorants and antioxidant with a huge growing market is highly susceptible to photo/thermal degradation, which demands real-time sensors. Hence, here a transparent upconversion nanoparticles (UCNPs) strip, having Yb 3+ 30 mol % Tm 3+ 0.1 mol % β-NaYF 4 UCNPs which shows intense 475 nm emission, has been developed. This strip has been found sensitive to lycopene, down to 10 nM using a smart phone camera; which is due to static quenching confirmed by life time study. In comparison to previous paper strips, here the transparent strip has minimal scattering with maximum sensitivity in spite of not using any metal quenchers. An increase in strip hydrophobicity during the fabrication process complements the strip to selectively permeate and present an extraction-free substitute analysis to chromatography. Hydrophobicity also adds the capability to reuse the strip with ~100 % luminescence recovery.
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