Super Paramagnetic Nanoparticles as a Reusable Delivery System of Pesticides

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The utilization of pesticides to protect agricultural productions and insect infestations for health and hygienic purposes has raised great concerns in the literature associated with soil, water, animal life, and human health. It is estimated that over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species. Recently, the use of magnetic nanoparticles was proposed for the recovery of pesticides by adsorption technique. In this study, novel and reusable magnetic nano-pesticides were synthesized with highly stable superparamagnetic iron oxide nanoparticles (SPIONs). The synthesis was repeated three time to ensure reproducibility. Polymer passivated hydrophilic and hydrophobic SPIONs were prepared using a solvothermal method, and were later amino functionalized using APTES. Furthermore, numerous pure and commercial pesticides were chemically attached to and physically adsorb on SPIONs. As-synthesized SPIONs were characterized by several analytical techniques. FE-SEM images displayed the spherical-shaped NPs having diameters around ~20 nm. XRD results indicated the formation of the magnetite (Fe_3O_4) phase. The high stability of SPIONs was proven using Turbiscan analysis. FTIR spectra exhibited peaks at 3400 cm^{-1} and 1630 cm^{-1}, which confirmed that the pesticide will remain in-contact with the particles after recollection. The successful application of magnetic nano-pesticides and their potential reusability have been demonstrated as a state-of-the-art technology for effective substitution of modern-day pesticides used in agriculture and households, thus eliminating their risk to the ecosystem.

Awards Won:

Third Award of $1,000