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Molecular Design and Synthesis of Different Polymer-Based Nanoparticles as Nanocarriers Using Irradiation Techniques

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Significant progress has been made during the past decade in preparing polymer-based nanoparticles (NPs) as nanocarriers for a wide range of applications. One of the next critical challenges is developing a green, robust and versatile method using irradiation techniques which allows the synthesis of different polymer nanoparticles into functional structures tailored for each specific purpose. In this work, we propose the molecular design and irradiation-assisted synthesis for the creation of polymer-based nanostructures, i.e., amphiphilic polymer core-shell NPs, inter-polymer complex NPs, polymer-capped metal NPs and hybrid NPs to be applied as nanocarrier for drug delivery, agrochemical entrapment, paint and coating additives. According to the different molecular structures, radiation-induced degradation, grafting and polymerization were carried out in particular water-based system at room temperature. Gamma rays and electron beam irradiation doses ranging from 5 to 100 kGy were selected and controlled to achieve nanoscale structure with the size of 10-300 nm. The amphiphilic core-shell water-soluble chitosan NPs (~120 nm) could encapsulate Berberine and Paclitaxel anticancer drugs with the drug content of 37% (w/w). Chitosan-polyacrylic acid interpolymer complex NPs (54 nm) efficiently entrap 20% (w/w) ammonium nitrate fertilizer and exhibit pH responsive function. Gold nanoparticle (5-50 nm) was successfully green synthesized in the water-soluble chitosan (WSCS) produced from radiation-induced degradation. In addition, electron beam can also accelerate the production of AuNPs in WSCS. The polymer brush shells were grafted onto silica NPs and silver NPs (5 nm) were then constructed on the polymer brush-grafted-silica NPs (98 nm). The obtained hybrid NPs effectively inhibited the growth of building fungi, i.e., *Spergillus Niger* and *Syncephalastrum Racemosum*. All types of polymer-based nanoparticles with different functions were successfully designed and prepared using irradiation techniques.

Country/Organization invited to participate

Thailand

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