Encapsulation of Drug Nanoparticles in Self-Assembled Macromolecular Nanoshells

Michael V. Pishko
Texas A&M University, College Station, TX 77843-3122
mpishko@tamu.edu

ABSTRACT

A layer-by-layer (LbL) self-assembly technique was used to encapsulate core charged drug particles in a polymeric nanoshell. This approach provides a new strategy in the development of polymeric vehicles for controlled release and targeting to diseased tissues and cells. A nanoshell composed of two biopolymers, poly-L-lysine and heparin sulfate, were assembled stepwise onto core charged drug nanoparticles. The exterior surface of the nanoshell was functionalized with biocompatible polymers(poly(ethylene glycol)) and targeting functional moieties, such as folic acid or protein ligands. Drug nanoparticles of dexamethasone, paclitaxol, and 5-fluorouracil were fabricated using a modified solvent evaporation technique, producing particles within a range of 150 to 300 nm. Assembly of the nanoshell was characterized by zeta potential measurements and XPS. Surface morphology of the encapsulated drug nanoparticles were viewed by TEM and SEM. XPS data collected for PEG modified drug nanoparticles confirmed that the peak at 286 eV represented the repeat unit in a PEG molecule. Zeta potential results re-confirmed PEG's presence at the surface. Cell uptake studies of PEG modified drug particles were performed using a flow cytometric assay and suggested that the neutral charge of the nanoshell results in decreased phagocytosis after 48 hours of incubation. Using paclitaxel nanoparticles with a breast cancer cell line, the nanoparticles were found to be effective in the absence of an excipient such as Cremophor EL. Strategies to create multifunctional nanoparticles and to deliver nanoparticles orally will also be discussed.