

Drug Layer-by-Layer Nanoencapsulation and Controlled Release

Malcolm Prouty¹, Zonghuan Lu¹, Nalinkanth Veerabadrán¹, Gopal Krishna¹, Alex Yaroslavov², Challa Kumar³, Yuri Lvov¹

¹Institute for Micromanufacturing, Louisiana Tech University, Ruston, LA; ²Chemistry Department, Moscow State University, Moscow, Russia; ³CAMD, Louisiana State University, Baton Rouge, LA, USA

1) Polymer micro and nanocapsules were prepared using template inorganic cores, which were dissolved later. Different enzymes and insulin were loaded in such capsules and their biocatalytic activity was confirmed. 2) Layer-by-layer (LbL) assembly of 30-50 nm organized polymer shells on drug microcrystals (Furosemide, Dexamethasone, Insulin) allowed their sustained controlled release. Combination of this method with a traditional liposome delivery approach is under development. Layer-by-layer self-assembly has demonstrated broad perspectives for encapsulating and controllable delivery of drugs: First, hydrophobic Dexamethasone was used as submicron cores. Nanolayers of protamine sulfate, chondroitin sulfate, gelatin B, and ferromagnetic Co@Au nanoparticles were assembled via alternate adsorption on a 0.5 μm Dexamethasone core and sustained 5-6 hour release was achieved. An external oscillating magnetic field was applied to switch on and accelerate the drug release. Magnetic field strength and frequency were optimized for the capsule opening. The second work involves LbL encapsulating of Dexamethasone, Nifedipine, and Furosemide in 50 nm diameter ceramic halloysite nanotubes. The results show sustained release from tubule lumen over several hours. In the third approach, Dexamethasone was included in CaCO_3 -lipid nanoporous microcores for controlled release. These technologies have great potential for new pharmaceutical formulation, such as controlled drug delivery applications.

