Electric Field-responsive Anisotropic Nano-architectures for Dual Drug Delivery Systems

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Anisotropic architecture composed of different discrete compartments with encapsulated nanoparticles (NPs) could be promising for a variety of biomedical applications because they provide unique physicochemical property and stimuli-responsiveness in each compartment, rendered by asymmetric distribution of functionalities and control over composition. Recently, it was reported that conducting polymer nanoparticles (CPNs) loaded with drugs or growth factors showed controlled release on electrical stimulus because conducting polymers (CPs) have an ability to display reversible redox in response to low electric signal. In this study, we report a new class of electric field-responsive anisotropic nano-architectures for dual drug delivery systems. Drug-loaded CPNs with homogeneous morphology and colloidal stability were prepared by micro-emulsion polymerization, and oppositely charged CPNs were separately incorporated into the individual compartments of the biodegradable triblock copolymers, poly(l-lactide)-poly(ethylene glycol)-poly(l-lactide) by electrohydrodynamic (EHD) co-jetting. These drug loaded CPNs within the anisotropic nano-architecture showed electric signal-responsive controlled drug release. Moreover, the use of CPNs was beneficial as they have a high surface-to-volume ratio, thus showing both excellent loading efficiency and stimuli-sensitive release profile. The drug release was found to be finely-controlled as a function of the number and strength of applied stimulus. Selective incorporation of drug-loaded CNPs into both compartments is promising for electrical stimulus-responsive therapeutic applications.

References

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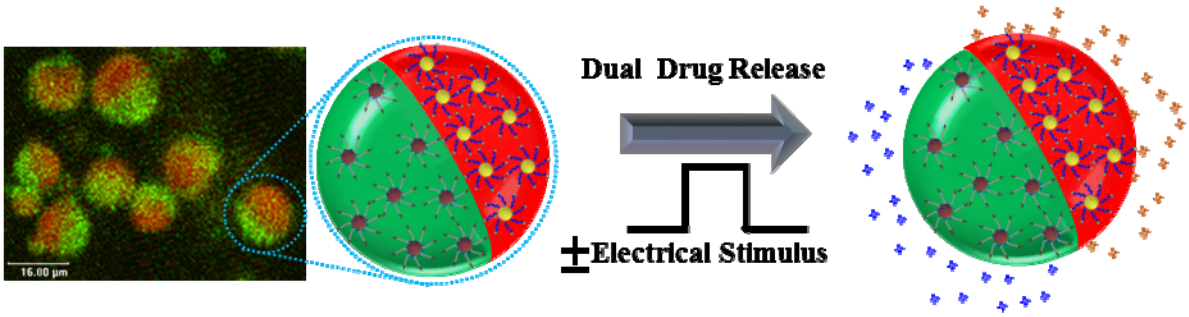
Figure



Cartoon of the anisotropic nanoarchitecture prepared by electrohydrodynamic co-jetting. Oppositely charged CPNs with entrapped drugs were separately encapsulated into individual compartments of the anisotropic nanoarchitecture. An electrical stimulus was used to selectively release drugs from the CPNs within each compartment. A confocal laser scanning microscopy image shows the anisotropic nanoarchitecture with encapsulated conducting polymer NPs in swollen state.