ABSTRACT
Biological discoveries and technology development hold promise in overcoming medical challenges, and when integrated, they shift the treatment paradigm towards better outcomes. A deep understanding of the diseased microenvironment is of paramount importance for engineering disease-specific drug delivery systems, which potentiate successful translation of biological findings into therapies. Each tissue in our body is composed of specific biological components that constitute a defined niche, and these characteristic compositions can be exploited to rationally design drug delivery systems to improve drug efficacy and reduce systemic toxicity. Tissue compositions alter significantly under pathological conditions at the genetic, molecular, and cellular levels, compared with normal tissue. Approaches that employ key biochemical or biophysical cues at the site of disease may effectively respond to endogenous stimuli for targeted drug delivery and on-demand drug release. In this seminar, I will first present drug delivery systems that selectively target bone through chemical modification with bisphosphonates (a group of molecules that have high affinity to bone) and physical encapsulation with nanoparticles. Next, I will describe a novel approach using an inflammation-targeting hydrogel for local drug delivery in the treatment of inflammatory bowel disease, a set of chronic inflammatory disorders in the gastrointestinal tract. In vivo validation of these engineered drug delivery systems in multiple animal models will be covered. Finally, I will discuss future prospects of targeted drug delivery for the treatment of skeletal and gastrointestinal diseases.