

**Project title:** Design of Sensitively Hydrogel-based Intelligent Systems for Controlled Drug Delivery

**Project description:**

It would be most desirable for drug release to match a patient's physiological needs at the proper time and/or proper site. This is why there is a great interest in the development of controlled drug delivery systems (DDS). Drug delivery technology can be brought to the next level by the fabrication of smart materials into a single assembled device that is responsive to the individual patient's therapeutic requirements and able to deliver a certain amount of drug in response to a biological state. Such smart therapeutics should possess one or more properties such as proper drug protection, local targeting, precisely controlled release, self-regulated therapeutic action, permeation enhancing, enzyme inhibiting, imaging, and reporting. This is clearly a highly challenging task and it is difficult to add all of these functionalities in a single device.

The major research interests are to develop intelligent multi-functional systems for controlled drug delivery based on environmentally sensitive hydrogels. Such systems would need to exhibit good biocompatibility and functionality, serving as drug delivery carriers for oral, buccal, rectal, vaginal, ocular, epidermal and subcutaneous applications. In our laboratory, an assembled DDS that can integrate multiple functions in a single system has been fabricated to achieve multifunctions such as drug protection, self-regulated oscillatory release, and targeted uni-directional delivery by a bilayered hydrogel design with the self-folding mechanism and simple surface mucoadhesion.

Based on the self-folding mechanism, by using various stimuli-sensitive hydrogels, assembled devices can be activated by pH, temperature, pressure, ionic strength, electromagnetic radiation, buffer composition or the concentration of glucose. Thus, optimization of gate and device design, as well as the proper choice of hydrogel materials, the DDS described in this study has the potential to provide the desired release pattern for a broad range of therapeutic uses.

Most conventional drug and chemical delivery systems are based on polymers or lipid vesicles. These synthesized materials often lack well defined properties due to their inherent structures. On the other hand, for biomolecular delivery used in inter- and intra-vascular applications, the device need be reduced to micron-sized or smaller. Current work focuses on the design of miniaturized DDS by using polymer micro-fabrication and integration techniques.

**Figures:**

