Abstract

The design and development of polymeric materials capable of responding to an external stimulus has been receiving a consistent focus for drug delivery system, protein delivery, bioprinting and tissue engineering applications. These smart polymers mimicking the biological system in a controllable and predictable fashion that challenges researcher to develope new stimuli responsive polymeric system for specific biomedical applications. Poly (N-isopropylacrylamide) is most widely studied temperature responsive polymer. A majority of previous studies deal with the improving of mechanical strength and modification of the surfaces of polymers. There is no adequate literature available in respect to PNIPAM based hydrogels that show dual responsive i.e. temperature as well as electric field triggered release of drug molecules through hydrogels. These research works cover the general area of thermo responsive polymers/hydrogels and encompass method of fabrication hydrogel based drug delivery systems for controlled and targeted therapeutic applications.

The first part of this thesis consists of fundamental aspects of the synthesis, functionalization and characterization of thermo responsive copolymer constructed from N-isopropylacrylamide (NIPAM) and functional comonomer 2-acrylamido-2-methylpropane sulphonic acid (AMPS) using poly (ethylene glycol) (PEG) as macroinitiator. Fourier Transform Infrared (FTIR), H$^1$ Nuclear Magnetic Resonance (NMR) confirmed the copolymerization between N-isopropylacrylamide (NIPAM), 2-acrylamido-2-methylpropane sulphonic acid (AMPS), poly (ethylene glycol) (PEG). While second part of the thesis focuses on the preparation of micro and bulk hydrogels.
In particular, the roles of ionic monomer on swelling-deswelling transition of hydrogels on exposure to a range of environmental stimuli including temperature, salt concentration were discussed. The incorporation of 2-acrylamido-2-methylpropane sulphonic acid (AMPS) broadens the volume phase transition temperature of hydrogels. The thermodynamics and network parameters of hydrogel have been evaluated to know the feasibility of hydrogels for biomedical applications. The controlled release characteristic of theophylline (TH) as model drug through hydrogels at temperature 37°C at pH 7.4 was studied. The result shows that the release of theophylline depends on the amount of AMPS present in the feed composition.

Furthermore, electric field induced swelling-shrinking behavior of hydrogels and drug electrophoresis was discussed. The normalized swelling ratio and entrapment efficiency % of methylene blue (MB) increases with increasing 2-acrylamido-2-methylpropane sulphonic acid (AMPS) in the feed composition of hydrogels.

**Key words:** Temperature responsive, Hydrogels, Controlled drug release, Swelling ratio, N-isopropylacrylamide, 2-acrylamido-2-methylpropane sulphonic acid, Drug delivery system, electric field