Synthesis of Thermoresponsive pNIPAM-b-HEA Block Co-Polymer Hydrogels for Drug Delivery Applications

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Age-related macular degeneration (AMD) is ranked as the third major global cause of blindness as reported by the World Health Organization. At present posterior ophthalmic drug delivery procedures are used for AMD patients, but are short lasting and require frequent visits. Improvements for prolonged and gradual drug release within the therapeutic window is the primary focus of ophthalmic drug delivery research endeavors. This novel investigation was conducted to develop an injectable, water soluble hydrogel for a more sustained release kinetics of a hydrophilic drug. A novel block copolymer hydrogel of poly(N-isopropylacrylamide) and 2-hydroxyethylacrylamide (HEA) has been synthesized using RAFT polymerization in order to control molecular weight and polydispersity. Four different block copolymer combinations were tested by varying the chain length of HEA and the location of the hydrazide functionalization in the pNIPAM-b-HEA. It was observed that the hydrogels displayed biologically relevant thermoresponsive properties through in vitro gravimetric swelling studies, by a gradual intake and release of PBS solution. The rapid kinetics of this chemistry in aqueous environments and the hydrolytic properties of hydrazide functionalization can improve in situ release kinetics. If introduced as a mechanism to deliver drugs to the eyes, it would be more practical than the current posterior ophthalmic drug delivery procedures for patients. Additionally, it requires no change in drug delivery procedure as it is injectable at the target site, optically clear to not hinder vision, made of readily available chemicals and is biodegradable, thus requiring no surgical procedure to remove the hydrogel from the body after the drug has been released.