Intelligent hydrogels have attracted much attention in soft matter research because they are able to display a high sensitivity to external stimuli. Poly-N-isopropylacrylamide (P-NIPAAm) hydrogels are known to undergo a reversible phase transition from water soluble to insoluble, if heated to temperatures above 32 °C, the lower critical solution temperature (LCST) of the gel. The phase transition involves clouding of the hydrogel network and expulsion of incorporated water. This property renders the hydrogels attractive for technical applications in the fields of sensors, actuators, switches and drug delivery systems. However, pure P-NIPAAm hydrogels only show weak mechanical stability and poor, not fully reversible swelling behaviour constricting their applications. Aim of our work is to overcome these limitations. For this purpose we copolymerize NIPAAm with polymerizable surfactants (surfmers) in a one-step reaction using gamma-irradiation [1]. A chemically and physically cross-linked network structure is formed consisting of blocks of P-NIPAAm and polymerized surfmer, the polymerized micelles acting as additional cross-linking units (Figure 1).

In our contribution the results on copolymer hydrogels containing NIPAAm and one of the cationic surfmers (2-methacryloylethyl)dodecyltrimethylammonium bromide, 11-methacryloylundecyltrimethylammonium bromide and 11-acryloyloxyundecyltrimethylammonium bromide will be presented. The phase behaviour of NIPAAm-surfmer comonomer solutions will be characterized and SANS studies of size, shape and dissociation of micelles in monomer solutions with and without NIPAAm will be presented. The influence of the structure of the surfmer and the chemical composition on the mechanical stability of the gel and its thermoresponsive behaviour will be described. The studies indicate that the surfmer-containing hydrogels show increased and fully reversible swelling behaviour as well as an improved mechanical stability. Presence of surfmer also influences the LCST of the hydrogels. Furthermore, the functionalization of the hydrogels via counterion exchange will be described as well as the possibility to use these systems for controlled release.