hydrogels are more common due to their self-assembled nature with hydrophobic and electrostatic interactions, and hydrogen bonding important for developing cross-links (Aulisa et al. 2009). As these molecular forces are weaker than covalent bonds they can be disrupted allowing the hydrogel network to flow. Shear-thinning is an optimal property for the precise delivery of a hydrogel to wound site, for example using a simple syringe. The shear force require to move the hydrogel out of the syringe is sufficient to enable the formulation to display liquid-like, flowing properties. These subsequently recover their elastic gel-like properties upon removal of shear force after application. MAX8 was proven to be an excellent shear thinning gel for the potential encapsulation and delivery of mesenchymal stem cells (Haines-Butterick et al. 2007). When an appropriate shear stress is applied, the MAX8 hydrogel shear-thins resulting in a low-viscosity gel. However, when shear has stopped, the gel quickly recovers its initial mechanical rigidity and gel-like properties. Shear-thickening natural-based hydrogels do exist, for example the Craig group developed a cysteine containing elastin-like polypeptide which formed covalent disulphide cross-linked networks in hydrogen peroxide and increased shear thickening up to an applied threshold force at concentration of 2.5% w/v (Xu et al. 2012). An applied force above a maximal defined threshold leads to shear-thinning properties and limits the wider use of these gels in medical context.

Light-Triggered Hydrogels

Light can also be used as an external stimulus to trigger the process of self-assembly and photopolymerization is commonly employed throughout the polymer industry to create a vast library of synthetic industrial and medical materials. Its use within peptide self-assembly has also been studied. Cui and colleagues incorporated a photoacid generator into liposomes which acted to lower the pH upon exposure to light. This was a successful approach in triggering the self-assembly of peptides by light activation within a spatially confined acidic environment (Lee et al. 2008). Schneider and Pochan have also developed a light triggered β-hairpin system based on the MAX peptide motif, termed MAX7CNB. A cysteine residue was introduced into the hydrophobic face of the peptide primary structure and a photocage (α-carboxy-2-nitrobenzyl) was then attached to the thiol group of this cysteine. Self-assembly could be controlled via specific wavelengths of UV light ($260 < \lambda < 360$ nm). The photocage prevented the folding of the peptide to a β-hairpin until exposure to light in the UV spectrum caused decaging and self-assembly (Haines et al. 2005). Using light to drive the self-assembly process has the advantage that it should not perturb the solution but interacts only with the material, meaning that it should not cause localized changes in the environment (e.g., pH) which may affect parameters such as drug release. However, the widespread use of light as a trigger throughout biomedicine is limited by its inability to effectively cross dense tissues (Carling et al. 2015).

Electrical-Responsive Hydrogels

Electronic signals are fundamental to the optimum functioning of human systems however there is a major challenge in combining biofunctional hydrogel materials