

genetic mutation. Hence, systems allowing the curing of hydrogels with visible light have been designed. Camphorquinone-10-sulfonic acid was used for the curing of PEG trithiol and PEG dialkene (Grube and Oppermann 2013) using blue light. Others have used green light to activate thiol-ene chemistry with Eosin Y and triethanolamine (Xu and Boyer 2015). Thiolated heparin was crosslinked with PEG diacrylate using Eosin Y and the modulus of the resulting gel was varied in the range of 0.3–11 kPa by changing the polymer concentration, the ratio of crosslinker and the functionality number of the PEG acrylate (Fu et al. 2015).

Biofunctionalization and micropatterning of thiol-ene hydrogels

The availability of cysteine residues in peptides and proteins allows their chemoselective oriented coupling to biomaterials via thiol-ene chemistry (Costa et al. 2014; Dondoni 2008). This concept has been applied for the biofunctionalization of hydrogels, making use of residual alkene moieties to couple peptides such as the cell adhesive RGD sequence. PEG-norbornene derived gels were functionalised with the CGRGDS, CGVGVAPG and CGGTPGPQGIAGQRGVV peptides mimicking the properties of fibronectin, elastin and collagen 1, respectively (Gould et al. 2012). This allowed the modulation of the expression of α -smooth muscle actin by valvular interstitial cells. Spotted microarrays of peptides and dyes were generated using thiol-ene coupling at the surface of hydrogels and could allow the development of high throughput microarrays for *in vitro* cell-based assays (Gupta et al. 2010). Similar strategies have been applied to dextran (Mergy et al. 2012) and hyaluronic acid (Khetan et al. 2009) hydrogels. Poly(2-oxazoline) hydrogels are also attractive platforms for *in vitro* cell culture and tissue engineering as they display similar cytocompatibility and bioinertness to PEG hydrogels and can be designed to display controllable alkene levels (Dargaville et al. 2014; Schenk et al. 2014). In particular, the antifouling properties of poly(2-methyl oxazoline) allowed the control of cell adhesion after functionalization with an RGD peptide. Cell adhesion was correlated with peptide density, confirming the specificity (integrin mediated) of this platform (Farrugia et al. 2015).

The ability to control thiol-ene chemistry by light also offers interesting opportunities for the patterning of hydrogels chemistry and mechanical properties. Burdick and co-workers micropatterned norbornene-functionalised hyaluronic acid with fluorescently tagged peptides (Gramlich et al. 2013). Peptide patterns were generated with high resolution (20 μm , Fig. 1c) and a good penetration depth (100–200 μm). A similar strategy was used to chemically pattern alkyne-azide hydrogels in 3D with tagged thiols and peptides (DeForest et al. 2009). Therefore thiol-ene chemistry, potentially in combination with other click chemistry approaches, offers attractive features for the control of hydrogel chemistry in 3D and the direction of cell behaviour and tissue formation. The ability to control the crosslinking density and mechanics of hydrogels with light was exploited to pattern the mechanical properties of hyaluronic acid-based hydrogels (Marklein and Burdick 2010; Khetan et al. 2013; Khetan et al. 2009) and control cell spreading in 2D and regulate stem cell phenotype in 3D.

Thiol-ene based hydrogels are attractive systems to control the chemical and mechanical properties of the cell microenvironment in 3D. These platforms are