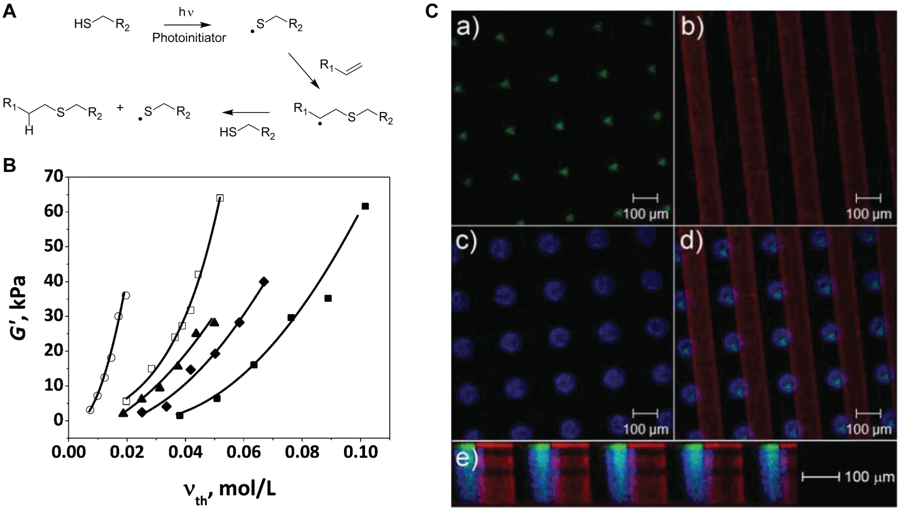

Fig. 1. (A) Mechanism of thiol-ene radical coupling. (B) Control of the mechanical properties (G', storage modulus) of poly(acrylamide) gels (open symbols) and thiol-ene gels (filled symbols) as a function of network density (νth) and molecular weight (Grube and Oppermann 2013). (C) Thiol-ene patterned hydrogels using three subsequent patterning steps and distinct tagged peptides (Gramlich et al. 2013).

monosubstituted alkenes react faster than those bisubstituted or than internal alkenes, suggesting that steric hindrance plays an important role in determining reaction kinetics (Roper et al. 2004). In the case of cyclic alkene molecules (e.g., norbornene), strain energy significantly increase reaction rates. Finally, increased electron density close to the alkene moiety speeds the rate of propagation (Cramer et al. 2003b). Hence the following coupling rates were proposed for different alkenes: norbornene > vinyl ether > vinyl silazane > acrylate > ally ether. These results are in agreement with computational models highlighting the importance of the stability of the carbon radicals formed (Northrop and Coffey 2012).

The initiation and termination stages are other important steps in thiol-ene coupling and play important roles for the design of thiol-ene based hydrogels. Several types of initiators have been proposed: scission-based initiators, activated by light or thermally, and hydrogen abstraction initiators. Photo-activated scission initiators such as 2,2-dimethoxy-2-phenyl acetophenone perform better in thiol-ene systems (Uygun et al. 2010; Campos et al. 2008). However, the hydrophobicity of this molecule does not allow its use for hydrogel formation and the hydrophilic and relatively cytocompatible 2-Hydroxy-4′-(2-hydroxyethoxy)-2-methylpropiophenone is usually preferred (Costa et al. 2014). Similarly, the photoactivated co-initiating system formed of Eosin Y and triethanolamine allowed the fast formation of hydrogels (Fu et al. 2015; Boyer and Xu 2015). Termination steps via bimolecular radical recombinations have important implications for the use of thiol-ene reactions for macromolecular design (Reddy et al. 2006; Koo et al. 2010). However, it should be noted that these effects were only important for large end-functionalised macromolecules and are not reported for