photocrosslinkable chitosan (Az-CH-LA). Photocured Az-CH-LA hydrogels showed better sealing properties as a biological glue when compared with the fibrin glue, having great potential for tissue adhesive applications. Similar to a photocurable gelatin modification method, vinylbenzoic acid-conjugated chitosan can be prepared via reaction between amino groups of chitosan and 4-vinylbenzoic acid in the presence of EDC (Matsuda and Magoshi 2002). Another example of preparing photocurable chitosan is to utilize glucosidic unit of chitosan to be modified with benzoyl chloride and methacryloyl chloride (Gao et al. 2014). In this synthesis method, chitosan was dissolved in methane sulfonic acid at room temperature, and two acyl chlorides was added drop-wise to the chitosan solution, being kept stirred for 3–4 h (Fig. 7C). By varying the ratio of benzoyl chloride and methacryloyl chloride, the photocurable chitosan's curability and solubility in organic solvents could be controlled. Bioscaffolds made from photocurable gelatin/chitosan held great potential for cell-based therapy for many devastating human diseases including spinal cord injury.

Dextran-based photocurable hydrogels

Dextran is a bacterial polysaccharide, which consists of main chains from α-(1,6) D-glucopyranosyl units. The linkages and branches of dextran depend on the original bacterial strain. In general, dextran is rich in hydroxyl group. It has been studied as a carrier for drugs, peptides and proteins (Coessens et al. 1996; He et al. 2015a; He et al. 2015b; Lin et al. 2012; Rowland 1977; Schacht et al. 1985; Schacht et al. 1990; Van Tomme and Hennink 2007; Zhong and Gong 1994).

A photocurable dextran was prepared through the reaction of dextran with bromoacetyl bromide and sodium acrylate via hydroxyl group. In this method, dextran went through bromoacetylation in lithium chloride/dimethylformaide (LiCl/DMF) with pyridine. Subsequently, sodium acrylate was added into the solution at 40ºC. Another type of photocurable dextran, dextran methacrylate, was synthesized through the reaction of dextran with MAA, whose structure is illustrated in Fig. 7D (Kim and Chu 2000, 2009). LiCl/DMF was used as a reaction solvent and MAA was diffused to react with the hydroxyl groups of dextran. A wide range (9~75%) of the DS of dextran methacrylate was obtained through control over some parameters (temperature (40~80ºC), reaction time (5~30 h), a molar ratio of MAA (0.0093~0.0370) to hydroxyl groups (0.0185), and a catalyst (triethylamine) concentration (1.85×10^{-4}~1.85×10^{-3}) (Kim and Chu 2000). In addition, dextran methacrylate was explored to be photocrosslinked by visible light using (−)- riboflavin (0.01~0.5 wt%) as a photoinitiator and L-arginine (5~10 wt%) as a co-initiator with a fluorescence light exposure for 15~40 min (Kim and Chu 2009). Photocrosslinkable dextran glycidyl methacrylate was synthesized as follows: dextran was dissolved in anhydrous dimethylsulfoxide (DMSO) containing dimethylaminopyridine (DMAP), and glycidyl methacrylate was added to the dextran solution. The reaction proceeded for 24 h at room temperature. The hydrogel mixture of photocurable dextran glycidyl methacrylate and scleroglucan was explored for injectable drug delivery applications (Corrente et al. 2013).