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Click chemistry and its unique benefits in composite formulation

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CLICK CHEMISTRY AND ITS UNIQUE BENEFITS IN COMPOSITE FORMULATIONS

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Although proposed only 15 years ago, "click" chemistry has already become a powerful tool in many synthetic/preparatic schemes in polymer science. The simplicity and robustness of "click" chemistries render them ideal candidates in engineering composite materials with well-defined physiochemical properties for vast range of applications. Herein we present the advances in the implementation of thiol-X "click" chemistries in various composite materials, exemplified by dental restoration materials, shape memory programmable composites/laminates and latex composite materials. In the first example, we developed a series of thiol-ene monomers in which esters are absent so that they are hydrolytically stable in basic conditions. We strengthened these thiol-ene polymers with functionalized silica nanoparticles (up to 65 wt% loading). Compared with the commercialized polymethacrylate systems, these polymeric composites show exceptional stability in both chemical and mechanical properties. Second example involves a two-stage thiol-isocyanate-methacrylate network polymer used for fabricating of programmable surface patterns and geometric shapes, which are induced by external strain and are erasable or permanently fixable. Moreover, the narrow and highly controllable glass transitions were also utilized for constructing layer-by-layer multiple shape memory laminates. Further, composites with multiple Tg's were also prepared by polymerization induced *in situ* phase transition, and polymeric microparticle-filled thiol-Michael materials. In final example, several novel latex materials were developed by the thiol-Michael addition miniemulsion polymerization. Inherently functionalized latex films were shown to undergo facile further surface functionalizations, as well as the dual-cure latex materials by a second stage photo-polymerization of excess acrylates after the first stage off-stoichiometric thiol-acrylate Michael addition polymerization.

References

(1) Chatani, S.; Sheridan, R. J.; Podgórski, M.; Nair, D. P.; Bowman, C. N. *Chemistry of Materials* **2013**, *25*, 3897.

(2) Chatani, S.; Gong, T.; Earle, B. A.; Podgórski, M.; Bowman, C. N. *ACS Macro Letters* **2014**, *3*, 315.

(3) Chatani, S.; Wang, C.; Podgórski, M.; Bowman, C. N. *Macromolecules* **2014**, *47*, 4949.

(4) Podgórski, M.; Chatani, S.; Bowman, C. N. *Macromolecular Rapid Communications* **2014**, *35*, 1497.

(5) Podgórski, M.; Nair, D. P.; Chatani, S.; Berg, G.; Bowman, C. N. *ACS Applied Materials & Interfaces* **2014**, *6*, 6111.

(6) Wang, C.; Podgorski, M.; Bowman, C. N. *Materials Horizons* **2014**, *1*, 535.

(7) Podgorski, M.; Becka, E.; Chatani, S.; Claudino, M.; Bowman, C. N. *Polymer Chemistry* **2015**, *6*, 2234.

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