Lactose functionalized polyurethanes/polyesterurethanes as biomaterials

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Shape memory polymers (SMPs) are a class of responsive polymers that have attracted attention in designing biomedical devices because of their potential to improve minimally invasive surgeries. Use of porous SMPs in vascular grafts has been proposed because porosity aids in transfer of fluids through the graft and growth of vascular tissue. However, porosity also allows blood to leak through grafts so precollating the materials is necessary. Here hydrogels have been synthesized from acrylic acid and N-hydroxymethyl acrylamide and coated around a porous SMP produced from lactose functionalized polyurethane-ureas. The biocompatibility of the polymers used to prepare the cross-linked shape memory material is demonstrated using an in vitro cell assay. As expected, the hydrogel coating enhanced fluid uptake abilities without hindering the shape memory properties. These results indicate that hydrogels can be used in porous SMP materials without inhibiting the shape recovery of the material. Aside from the obvious advantage of having a shape memory polymer/polyurethanes were used in this work because they are widely used in biomedical applications due to their toughness, durability, flexibility, and biocompatibility. The polyurethanes prepared from lactose diamine have been shown to have excellent blood compatibility. However, synthesis of the carbohydrate containing polyurethanes requires lengthy and complicated procedures. This inspired our group to look for alternative and more efficient routes for bringing carbohydrates and polyurethanes together as biomaterials. Specifically, thiol-ene click chemistry between a lactose thiol and polyurethanes containing pendant allyl groups. Polyurethanes were also copolymerized with poly(caprolactone)-diol (PCL-diol) to impart biodegradability on the material, a common requirement of biomaterials.

Hypothesis

Lactose containing polyurethanes will be bioresponsive shape memory polymers. Incorporating hydrogels into the shape memory network will enhance fluid uptake without disturbing the shape memory process. Subsequently cross-linking of lactose containing polyurethanes with polyurethanes will afford a biodegradable shape memory material with a large scope of applications.

Current method

Pre-polymer characterization

Shape memory foam characterization

New method using Thiol-ene chemistry

Materials synthesis

Conclusions

Future Work

Acknowledgments