Biocompatibility and Thermal Properties of Absorbable Thermoplastic Polyurethanes

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Novel Absorbable polyurethanes were prepared from highly reactive isocyanates that are similar to MDI but are biodegradable and have tunable hydrolytic degradation profiles. What distinguishes our isocyanates from the commonly used isocyanate, MDI, is the presence of a degradable linkage bridging the aromatic rings in figure 1(b) instead of the non-degradable methylene group as shown in figure 1 (a). Furthermore, the degradable linkage in our isocyanates is derived from safe and biocompatible glycolic acid, lactic acid, caprolactone, p-dioxanone and diols such as ethylene glycol. These monomers are the key components of majority of biodegradable polymers used to make commercial medical devices.

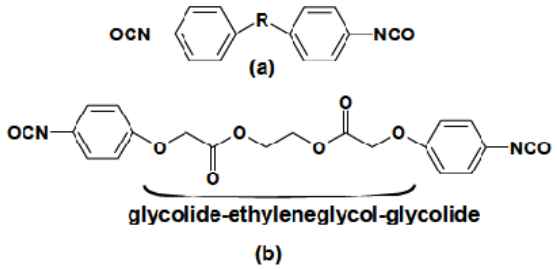

Figure 1 (a) MDI (b) Hydrolysable isocyanate

Polyurethanes derived from these novel isocyanates and chain extender diols are expected not only be biodegradable but also possess for the first time degradable hard segments. Furthermore, the hydrolytic degradation rate of these polyurethanes can be controlled by (a) deriving the degradable hard segment from different safe and biocompatible molecules and (b) varying the chain length of the repeat units derived from absorbable, safe and biocompatible glycolic acid, lactic acid, p-dioxanone and caprolactone monomers in the linker bridging the aromatic rings in the hard segment. Moreover, these polyurethanes will have toughness and mechanical properties of that of commercially available medical grade polyurethanes and biodegradability of commercial biodegradable polymers. In addition, the derived biodegradable polyurethanes will degrade into safe and biocompatible degradation products unlike polyurethanes derived from MDI.

This paper describes our research efforts to develop novel safe, biocompatible and absorbable diisocyanates and novel absorbable and biocompatible polyurethanes from them. The polyurethanes prepared from the new isocyanates will be discussed as potential candidates for drug delivery, tissue engineering, adhesion prevention and other implantable medical device. Synthesis and characterization of these monomers and polymers along with their biocompatibility and thermal properties will be presented and discussed.

Results and Discussion: Figure 2 below displays the structures of hydrolysable isocyanates, polyols and chain extender used to prepare polyurethanes of the present study. Figure 3 displays the representative general structure of absorbable polyurethanes of the present study.

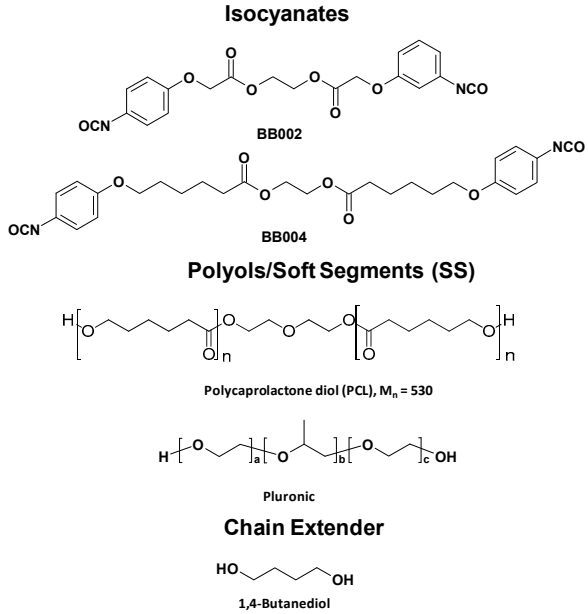

Figure 2. Structures of isocyanates, polyols and chain extender

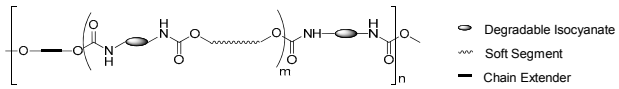

Figure 3. Representative Structure of Absorbable Polyurethanes

References:

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2. Parraka J et al. Bioresorbable Polyurethanes with Degradable Hard Segments, Poster 616, Society for Biomaterials Annual Meeting 2009.
3. Scott A Guelcher. and Jeff O Hollinger, Biomedical Engineering Series: An introduction to Biomaterials.; Polyurethanes pp 161 CRC Press, Boca Raton, FL 2006