Absorbable Polyurethanes from Functionalized Phenylalanine

Rao S Bezwada and Neeti Srivastava
Bezwada Biomedical LLC
15-1 Ilene Court, Hillsborough
New Jersey, USA 08844

Polyurethanes represent a diverse family of materials with the versatility of being rigid, semi-rigid and flexible. In addition, polyurethanes have also demonstrated excellent blood compatibility, outstanding hydrolytic stability, superior abrasion resistance, excellent physical strength, high flexural endurance and ease of processability. These properties of polyurethanes have resulted in their use in a varietyof biomedical applications, including short-term medical devices (catheters, endotracheal tubes, cannulas), long-term implantable devices (vascular prostheses, intra-aortic balloons), tissue engineering scaffolds, infusion pumps and cardiac pacemakers. Such versatility and multitude of properties that can be obtained with polyurethanes result from the wide range of molecular variations that can be joined together via the urethane bond.

The majority of the medical grade polyurethanes are based on aromatic diisocyanate, MDI. In spite of excellent mechanical properties, biostable polyurethane cannot be used in biomedical applications where biodegradability of the polymer is a necessary prerequisite.

At Bezwada Biomedical, for the first time we have developed highly reactive Phenylalanine based 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 instead of the non-degradable methylene group. Furthermore, the degradable linkage in our isocyanates is derived from safe and biocompatible glycolic acid, lactic acid, caprolactone and p-dioxanone.

Results: Figure 1 displays the structures of various phenylalanine based isocyanates. Polyurethanes derived from these isocyanates with chain extender diols and amines will not only be absorbable but will have hydrolytically unstable urethane and urea hard segment. Figure 2 displays the representative example of polyurethane derived from phenylalanine based diisocyanates.

Key aspects along with potential applications of these absorbable polyurethanes will be presented. Synthesis and characterization of selected macromers and oligomers will be presented. *In Vitro* hydrolysis and the controllable hydrolysis profiles will be discussed during presentation.

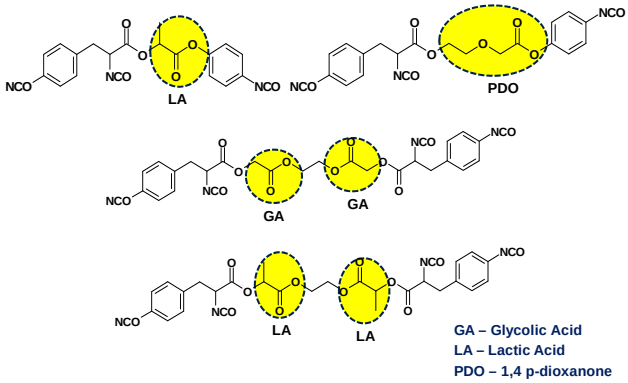

Figure 1. Phenylalanine based isocyanates

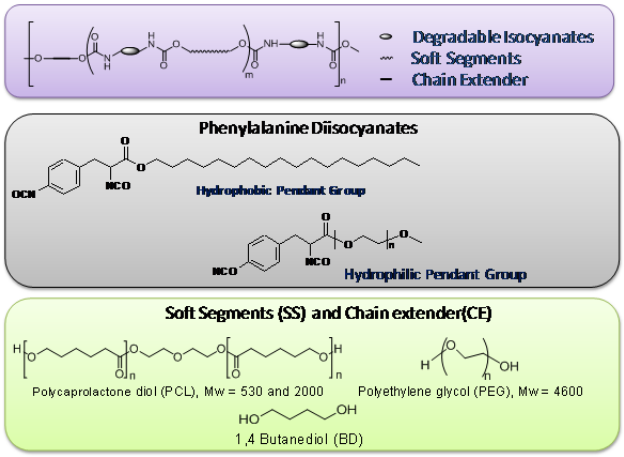

Figure 2. Phenylalanine based polyurethanes

Conclusions: For the first time, our company has developed aromatic amino acid (Phenylalanine, Tyrosine etc) based isocyanates with controlled hydrolytic degradation profiles. Polyurethanes derived from these isocyanates are expected to have toughness and mechanical properties of that of commercially available medical grade polyurethanes and absorbability of that of commercial bioerodible polymers. These polyurethanes are expected to degrade into safe and biocompatible degradation products and have controlled degradation profiles.

References:

1. Bezwada US Patent No. 8461372
2. Bezwada US Patent No. 8551519
3. Bezwada US Patent No. 8367747