Tunable Degradation and *In Vivo* Imaging of Poly(β-amino ester) Networks for Controlled Release Applications

D.L. Safranski[1], D.Weiss[2], J.B. Clark[2], W.R. Taylor[2,3,4], K. Gall[1,5]

[1]School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA, [2]Emory University School of Medicine, Atlanta, GA, [3]Atlanta Veterans Affairs Medical Center, Atlanta, GA, [4]W.H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, [5]Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, GA

Statement of Purpose: Abdominal aortic aneurysms are a leading cause of death in the U.S. with near 14,000 people dying from rupture each year. A biodegradable polymer extravascular scaffold has been proposed to deliver a therapeutic agent to address elastin and collagen degradation. Poly(β-amino ester) networks have been proposed as a possible candidate material due to the high degree of tailorability. Previous studies focused on altering degradation by changing the diacrylate to amine ratio for tissue scaffolds[1].

The objectives of this study are (1) control the degradation rate by using diacrylates of different chemical structure and (2) to evaluate the effect of varying chemical structure on the polymer implant fate *in vivo*. Variation of diacrylate chemical structure will further tailorability of scaffold design.

Methods: Poly(β-amino ester) networks were formed from hexanediol diacrylate (HDDA), poly(ethylene glycol) diacrylate (PEGDA), and 3-methoxypropylamine at select ratios of PEGDA:HDDA and an overall constant diacrylate to amine ratio. The reagents were mixed at 200 rpm at 90°C for 24 hours on rotary shaker to form acrylate terminated macromers. The macromers were subsequently photopolymerized with Irgacure 2959 at 0.5 wt% under a UV lamp at 365nm. 1 cm^2 square samples soaked in phosphate buffered saline, massed wet, dried for 24 hours, and massed again to determine change in weight for mass loss and water content. All animal experiments were conducted in accordance with the IACUC guidelines of Emory University. Networks of varying PEGDA:HDDA ratio were implanted subcutaneously on the back of eight week old immunocompetent male mice. A 4.7T MR system (Varian Anova Animal Imaging System, Palo Alto, CA) was used to monitor the implants.

Results: Networks were synthesized with 3 ratios of PEGDA:HDDA. Figure 1 shows the degradation profile of the networks, where increasing PEGDA:HDDA ratio increased the mass loss. Figure 2 shows the water content profile of the networks, where increasing PEGDA:HDDA ratio increased the water content. Figure 3 and Figure 4 show the MR images of the networks at 1 day and 6 weeks, respectively. Networks are intact at day 1; however, the 10:90 and 25:75 networks have changed position by 6 weeks.

Conclusions: By increasing the PEGDA:HDDA ratio, the amount of mass loss increases due to the increasing water content. The water content of the networks increases because PEGDA is more hydrophilic than HDDA. The increase in water content promotes mass loss by enhancing hydrolytic cleavage of the ester bond. The decrease in water content from 3 weeks to 8 weeks of the 25:75 network may be due to a change in hydrophilicity, where the PEGDA components degrade out first, leave the less hydrophilic HDDA components in place. The MR images allowed for tracking of implant position and state, where the networks with PEGDA changed position and mechanically failed. The mechanical failure may be due to the enhanced mass loss greater than 50% with the combination of the mechanically active environment of the subcutaneous implantation site. Future work will include optimization of mechanical properties and degradation under *in vivo* conditions.

References:

1. Brey DM. J. Biomed Mater Res Part A. 2008;85:731-741.

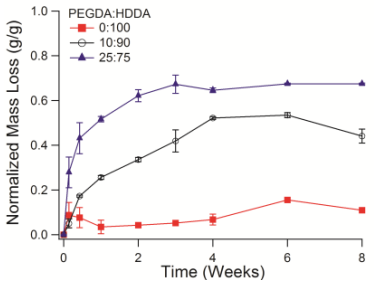

Figure 1. Degradation profile of PEGDA:HDDA networks over 8 weeks.

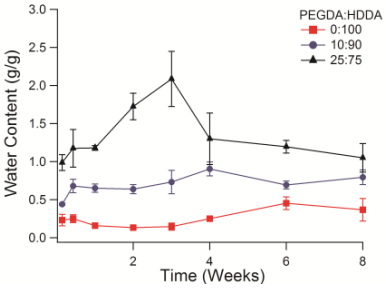

Figure 2. Water content profile of PEGDA:HDDA networks over

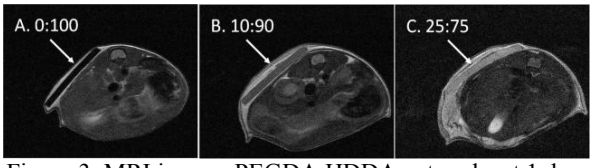

Figure 3. MRI images PEGDA:HDDA networks at 1 day.

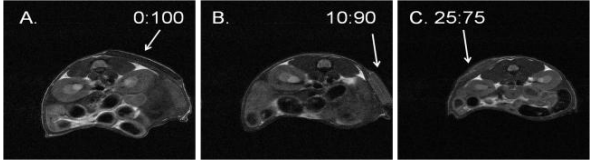

Figure 4. MRI images of PEGDA:HDDA networks at 6 weeks.