Douglas G. Mullen

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Education

Ph.D., Program in Macromolecular Science and Engineering – The University of Michigan
Ph.D. completed May 2010, conferred August 2010; Advisor – Professor Mark M. Banaszak Holl.
GPA: 7.358 / 9.0 (A = 8.0)
Title: Design of Multi-functional Drug Delivery Platforms

Masters of Science in Engineering, Program in Macromolecular Science and Engineering - The University of Michigan
M.S.E. conferred December 2007; Ph.D. candidacy attained September 2007

Bachelors of Science in Engineering, Mechanical Engineering – Duke University
B.S.E. conferred May 2005

Business Development Experience and Coursework

Frankel Commercialization Fund, Ross School of Business, The University of Michigan
Health Care Team (November 2009 – Present)

- The Frankel Commercialization Fund is a pre-seed investment fund that is focused on the commercialization of ideas generated at the University of Michigan. The Health Care Team invests up to $100,000 in each business.
- Evaluating technology and commercialization plans for early stage entrepreneurial ventures.
- Working with entrepreneurs on strategy and corporate development, and maintaining oversight of portfolio companies.

MBA Essentials and Entrepreneurship Program, Ross School of Business, The University of Michigan
(January 2009 – March 2009)

- Member of the inaugural 50 person class comprised of graduate students, professors, and university health system residents and fellows.
- Topics covered business economics, finance, accounting, management and negotiating skills, and marketing. Additional entrepreneurship topics included idea generation and protection, commercialization, feasibility analysis, competitive landscape analysis, business planning, and new venture funding.
- Member of project team that developed "quick pitch" to secure funding for a novel medical device.

Driving the Innovative Process (Ross School of Business): Investigated the process of transforming a new technological discovery into an innovative business. Focused on designing a business concept from new technology prior to the identification of a product or market. Utilized recent research in innovation, marketing, management, and sociology. (Winter 2008)

Business of Biology (Ross School of Business): Explored biology's transformative influence on the future of business, medicine, and health, and the complex ethical and legal issues that face society. Provided an overview of the collaborative research enterprise, the promise of personalized medicine and challenge for the biopharmaceutical industry, and the latest trends in venture investing. (Fall 2005)

Genetics and Biotechnology Policy (Ford School of Public Policy): Explored the new political and policy challenges that are raised by genetics and biotechnology. Topics included stem cells, genetically modified organisms, pharmacogenetics, international health policy, regulatory history, public perception of new science and technology, and the implications of genetics for insurance and employment. (Winter 2006)

Science and Engineering Courses in biomaterials, polymeric materials, polymer chemistry, polymer processing, polymer physics, and composites. Investigation, problem solving and design based upon the hypothesis driven scientific method. Frequently worked with project teams to execute assignments.

Research Experience

The University of Michigan, Michigan Nanotechnology Institute for Medicine and Biological Sciences
Mentors: Professor Mark M. Banaszak Holl and Dr. James R. Baker Jr. (November 2005 – present)

- Conducting interdisciplinary research in a team with disciplines ranging from applied physics to biomedical engineering to synthetic chemistry to medical clinicians.

Projects Include:

- Development of nano-sized polymer particles to selectively deliver anti-tumor drugs to cancer cells.
- Identification of one of the main barriers preventing widespread commercialization of biomedical nanomaterials in areas including targeted drug delivery.
- Development of novel designs that overcome challenges with reproducibility and heterogeneity for nanoparticles with biomedical applications.
- Synthesis, purification, and characterization of polymeric nanoparticles for biological research.
- Conducting feasibility analysis and developing commercialization plans for two different technologies.

Leadership Experience

Michigan Nanotechnology Institute for Medicine and Biological Sciences, The University of Michigan

- Led a research team of five first-year graduate students and three undergraduate students.

Duke University Sailing Team
President (2003, 2004), Vice President (2002)

- Directed the operation of the sailing team which had 51 members and was the largest club sport at Duke.

Duke Smart Home Project
Team Leader, HVAC Team; Member, Energy R & D Group (2003-2004)

- Led the team responsible for designing the automated heating system and the heat recovery from grey water system for the energy efficient house of the future which was built at Duke in 2007.
- Collaborated with engineers across multiple disciplines to integrate different systems for increased energy efficiency.

Michigan Health Engineered for All Lives
Floor Manager, Inventory Day (April 2008); Member, Mechanical Design Team (2008); Member-at-large (2007-2009)

- One of two floor managers who coordinated the efforts of 80 volunteers tasked to inventory the 8 floor warehouse containing donated medical equipment and supplies at World Medical Relief in Detroit, MI.

Executive Council of Duke University Sports Clubs
Vice President (2003, 2004) Publicity Chair (2002)

- The five person council is the governing body of the Duke Sports Clubs which have over 1,600 undergraduate student members. The council allocated the Sports Club Budget and the Sports Club Endowment, and determined Sports Club Policy.

Duxbury Harbormaster Department, Duxbury MA
Shift Supervisor, Asst. Harbormaster, Deputy Coastal Natural Resources Officer (Summer 2003, 2004, 2005)

- Conducted law enforcement, and search and rescue patrols primarily in the Marine Division.

Duxbury Bay Maritime School, Duxbury MA
Head Senior Sailing Instructor (Summer 2002), Senior Instructor (Summer 2001), Junior Instructor (Summer 2000)

Recent Awards and Achievements

Achievement Award for Outstanding Dedication and Service – The University of Michigan – Program in Macromolecular Science and Engineering (October 2009)

National Starch and Chemical Award – The University of Michigan – Program in Macromolecular Science and Engineering (October 2008)
For excellence in academics and research.

Excellence in Graduate Polymer Research Award – American Chemical Society, Spring Meeting (April 2008)

Rackham Regents Fellowship – University of Michigan – Rackham Graduate School (September 2005 - May 2008)

Recent Awards and Achievements con't

Raymond C. Gaugler Award – Duke University – Department of Mechanical Engineering and Materials Science (May 2005)
Presented to the senior who has made the most progress at Duke in developing competence in materials science or materials engineering.

Kevin D. Gorter Memorial Award – Duke University (May 2005)
Award is made annually to the student who has made the greatest contribution to the Sports Club program and best exemplifies the purposes of Sport Clubs at Duke University.

Pratt Undergraduate Research Fellowship – Duke University – Pratt School of Engineering (January 2004 – May 2005)

Duke University – Department of Mechanical Engineering and Materials Science (December 2004)
2nd Place in annual design contest

Patent Applications

"Dendrimer Based Modular Platforms" U.S. Patent Application Serial No. 61/140,480. Provisional Application Submitted: 12/23/2008

"Synthesis and Isolation of Dendrimer Systems" U.S. Patent Application Serial No. 61/237,172. Provisional Application Submitted: 08/26/2009

Peer Reviewed Publications

Mullen DG, Desai AM, Waddell JN, Cheng XM, Kelly CV, McNerny DQ, Majoros IJ, Baker JR, Sander LM, Orr BG, Banaszak Holl MM. The implications of stochastic synthesis for the conjugation of functional groups to nanoparticles. *Bioconjugate Chemistry* **2008**, *19*, 1748-52.

Erickson B, DiMaggio SC, **Mullen DG**, Kelly CV, Leroueil PR, Berry SA, Baker JR, Orr BG, Banaszak Holl MM. Interactions of poly(amidoamine) dendrimers with survanta lung surfactant: the importance of lipid domains. *Langmuir* **2008**, *24*, 11003-08.

Kelly C, Liroff M, Triplett L, Leroueil P, **Mullen, D**G, Wallace J, Meshinchi S, Baker JR, Orr BG, Banaszak Holl MM. Stoichiometry and structure of poly(amidoamine) dendrimer-lipid complexes. *ACS Nano* **2009**, *3*, 1886-96.

Chen J, Hessler JA, Putchakayala K, Panama BK, Khan DP, Hong S, **Mullen DG**, DiMaggio SC, Som A, Tew GN, Lopatin AN, Baker JR, Banaszak Holl MM, Orr BG. Cationic Nanoparticles Induce Nanoscale Disruption in Living Cell Plasma Membranes. *Journal of Physical Chemistry B* **2009**, *113*, 11179-85.

Hong S, Rattan R, Majoros IJ, **Mullen DG**, Peters JL, Shi X, Bielinska AU, Blanco L, Orr BG, Baker JR, Banaszak Holl MM. The role of ganglioside GM1 in cellular internalization mechanisms of poly(amidoamine)dendrimer. *Bioconjugate Chemistry* **2009**, *20*, 1503-13.

McNerny DQ, Kukowska-Latallo JF, **Mullen DG**, Wallace JM, Desai AM, Shukla R, Huang B, Banaszak Holl MM, Baker JR. RGD Dendron bodies; synthetic avidity agents with defined and potentially interchangeable effector sites that can substitute for antibodies. *Bioconjugate Chemistry*, **2009**, *20*, 1853-1859.

McNerny DQ, **Mullen DG**, Majoros IJ, Banaszak Holl MM, Baker JR. *Dendrimer Synthesis and Functionalization by Click Chemistry for Biomedical Applications. *In Click Chemistry for Biotechnology and Material Science (ed. Joerg Lahann), Wiley, 2009.

Thomas T, Majoros IJ, Kotlyar A, **Mullen DG**, Banaszak Holl MM, Baker JR. Cationic poly(amidoamine) dendrimer induces lysosomal apoptotic pathway at therapeutically relevant concentrations. *Biomacromolecules*, **2009**, *10*, 3207-3214.

Qi R, **Mullen DG**, Baker JR, Banaszak Holl MM. The mechanism of polyplexes internalization into cells: testing the GM1/Caveolin-1-mediated lipid raft mediated endocytosis pathway. *Molecular Therapuetics*, **2010**, *7*, 267-279.

Mullen DG, Fang M, Desai A, Baker JR, Orr BG, Banaszak Holl MM. A quantitative assessment of nanoparticle ligand distributions: Implications for targeted drug and imaging delivery in dendrimer conjugates. *ACS Nano*, **2010**, *4*, 657-670.

Prevette LE, **Mullen DG**, Banaszak Holl MM. Polycation-induced cell membrane permeability does not enhance cellular uptake or transfection efficiency. *Molecular Pharmaceutics*, **2010**, *7*, 870-883.

Mullen DG, Byrne EL, Desai A, van Dongen-Sohmer M, Barash MM, Baker JR, Banaszak Holl MM. Isolation and characterization of dendrimer with precise numbers of functional groups. *Accepted* **2010**.

Peer Reviewed Publications con't

Smith PE, Brender JR, Durr UH, Xu J, **Mullen DG**, Banaszak Holl MM, Ramamoorthy A. Solid-state NMR reveals the hydrophobic-core location of poly(amidoamine) dendrimers into biomembranes. *Journal of the American Chemical Society*, **2010**, *132*, 8087-8097.

Mullen DG, Byrne EL, Fang M, McNerny DQ, Desai A, Baker JR, Orr BG, Banaszak Holl MM. The effect of sub-optimal mass transport on partially acetylated dendrimer: Implications for nanoparticle-ligand distributions. *Accepted* **2010**.

Mullen DG, McNerny DQ, Desai A, Cheng X, DiMaggio SC, Kotlyar A, Wallace JM, Qin S, Kelly CV, Thomas TP, Majoros I, Orr BG, Baker JR, Banaszak Holl MM. Design, synthesis, and biological functionality of a dendrimer-based modular drug delivery platform. *Submitted* **2009**.

Waddell JN, **Mullen DG**, Orr BG, Banaszak Holl MM, Sander LM. Statistical effects of broad polydispersion in nanoparticles. *Submitted* **2009**.

Mullen DG, Banaszak Holl MM. Heterogeneous nanoparticle-ligand distributions: a major obstacle to scientific understanding and commercial translation. *Invited* **2010**.

Desai AM, Andreae M, **Mullen DG**, Baker JR. Acetonitrile shortage: use of isopropanol as an alternative elution system for ultra/high performance liquid chromatography. *Submitted* **2010**.

Mullen DG, Banaszak Holl MM. Best practices for PAMAM dendrimer purification and characterization. *In-preparation* **2010**.

Interests

Team Vanguard, competitive sailboat racing team (2006-present)
Headnotes, University of Michigan Law School a cappella group (2005-2009)

References

Mark M. Banaszak Holl
Professor
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