Benjamin S. Schuster, Ph.D.

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Professional Experience

Assistant Professor, Dept. of Chemical & Biochemical Engineering, Rutgers University — 2019 – pres.
Postdoctoral Associate, Dept. of Bioengineering, University of Pennsylvania — 2014 – 2018

Education

Ph.D., Biomedical Engineering, Johns Hopkins University — 2014
B.S., Biomedical Engineering, University of Minnesota, *with high distinction* — 2008

Research Experience

Postdoctoral Research — 2014 – 2018
University of Pennsylvania — Advisor: Daniel A. Hammer

- Awarded NIH Ruth Kirschstein National Research Service Award (F32).
- Engineered synthetic membrane-less organelles based on an intrinsically disordered protein (IDP) that self-assembles into liquid droplets. Demonstrated methods to enzymatically trigger droplet assembly and disassembly. Devised strategies to control organelle composition by targeting exogenous cargo molecules into the organelles.
- Discovered the sequence determinants of phase behavior for a prototypical IDP, in collaboration with computational biophysicists.

Graduate Research — 2009 – 2014
Johns Hopkins University — Advisor: Justin Hanes

- Thesis title: Probing and Overcoming Extracellular Barriers to Inhaled Nanomedicine.
- Discovered methods to enhance pulmonary drug and gene delivery for cystic fibrosis. Collaborated with clinicians and researchers to design nanoparticles and viruses capable of penetrating the lung's mucus barrier.
- Developed quantitative microscopy techniques and invented photoactivatable fluorescent nanoparticle probes for measuring diffusion in biological gels.

Undergraduate Research — 2006 – 2008
University of Minnesota — Advisors: David Odde, Victor Barocas, and Yiannis Kaznessis
National Institutes of Health — Advisor: Sriram Subramaniam

Honors and Awards

National Institutes of Health NRSA Postdoctoral Fellowship — 2016 – 2018
Johns Hopkins Center for Nanomedicine Award for Research Excellence — 2014
University of Minnesota Presidential Scholarship — 2004 – 2008
University of Minnesota Bentson Family Scholarship — 2004 – 2008

Publications

1. **Schuster BS**, Dignon GL, Tang WS, Kelley F, Ranganath AK, Jahnke CN, Simpkins AG, Regy RM, Hammer DA, Good MC, Mittal J. Identifying sequence perturbations to an intrinsically disordered protein that determine its phase separation behavior. *Under Review.* Preprint on bioRxiv: https://www.biorxiv.org/content/10.1101/2020.01.06.894576v1.abstract
2. Reed EH, **Schuster BS**, Good MC, Hammer DA. SPLIT: Stable Protein Coacervation using a Light Induced Transition. *Under Review.*

3. **Schuster BS**, Reed EH, Parthasarathy R, Janke CN, Caldwell RM, Bermudez JG, Ramage H, Good MC, Hammer DA. Controllable protein phase separation and modular recruitment to form responsive membraneless organelles. *Nature Communications* 2018; 9:2985.
4. Glantz ST, Berlew EE, Jaber Z, **Schuster BS**, Gardner KH, Chow BY. Directly light-regulated binding of RGS-LOV photoreceptors to anionic membrane phospholipids. *Proc Natl Acad Sci USA* 2018; 115:E7720-E7727.
5. Caldwell RM, Bermudez JG, Thai D, Aonbangkhen C, **Schuster BS**, Courtney T, Deiters A, Hammer DA, Chenoweth DM, Good MC. Optochemical control of protein localization and activity within cell-like compartments. *Biochemistry* 2018; 57:2590-2596.
6. **Schuster BS**, Allan DB, Kays JC, Hanes J, Leheny R. Photoactivatable fluorescent probes reveal heterogeneous nanoparticle permeation through biological gels at multiple scales. *Journal of Controlled Release* 2017; 260:124-133.
7. Schneider CS, Xu Q, Boylan NJ, Chisholm J, Tang B, **Schuster BS**, Henning A, Ensign LM, Lee E, Adstamongkonkul P, Simons BW, Wang SS, Gong X, Yu T, Boyle MP, Suk JS, and Hanes J. Nanoparticles that do not adhere to mucus provide uniform and long-lasting drug delivery to airways following inhalation. *Science Advances* 2017; 3(4):e1601556.
8. Chu KK, Mojahed D, Fernandez CM, Li Y, Liu L, Wilsterman EJ, Diephuis B, Birket SE, Bowers H, Martin Solomon G, **Schuster BS**, Hanes J, Rowe SM, Tearney GJ. Particle-tracking microrheology using micro-optical coherence tomography. *Biophysical Journal* 2016; 111:1053-63.
9. **Schuster BS**, Ensign LM, Allan DB, Suk JS, Hanes J. Particle tracking in drug and gene delivery research: state-of-the-art applications and methods. *Advanced Drug Delivery Reviews* 2015; 91:70-91.
10. Yu T, Chan KW, Anonuevo A, Song X, **Schuster BS**, Chattopadhyay S, Xu Q, Oskolkov N, Patel H, Ensign LM, van Zjil PC, McMahon MT, Hanes J. Liposome-based mucus-penetrating particles (MPP) for mucosal theranostics: demonstration of diamagnetic chemical exchange saturation transfer (diaCEST) magnetic resonance imaging (MRI). *Nanomedicine* 2015; 11:401-5.
11. Nance E, Zhang C, Shih TY, Xu Q, **Schuster BS**, Hanes J. Brain-penetrating nanoparticles improve paclitaxel efficacy in malignant glioma following local administration. *ACS Nano* 2014; 8:10655-64.
12. Birket SE, Chu KK, Liu L, Houser GH, Diephuis BJ, Wilsterman EJ, Dierksen G, Mazur M, Shastry S, Li Y, Watson JD, Smith AT, **Schuster BS**, Hanes J, Grizzle WE, Sorscher EJ, Tearney GJ, Rowe SM. A functional anatomic defect of the cystic fibrosis airway. *Am J Respir Crit Care Med* 2014; 190:421-32.
13. **Schuster BS**, Kim AJ, Kays JC, Kanzawa MM, Guggino WB, Boyle MP, Rowe SM, Muzyczka N, Suk JS, Hanes J. Overcoming the cystic fibrosis sputum barrier to leading adeno-associated virus gene therapy vectors. *Molecular Therapy* 2014; 22:14841493.
14. Kim AJ, Boylan NJ, Suk JS, Hwangbo M, Yu T, **Schuster BS**, Cebotaru L, Lesniak WG, Oh JS, Adstamongkonkul P, Choi AY, Kannan RM, Hanes J. Use of single-site-functionalized PEG dendrons to prepare gene vectors that penetrate human mucus barriers. *Angew Chem Int Ed* 2013; 52:3985-8.
15. **Schuster BS**, Suk JS, Woodworth GF, Hanes J. Nanoparticle diffusion in respiratory mucus from humans without lung disease. *Biomaterials* 2013; 34:3439-46.
16. Langham AA, Khandelia H, **Schuster B**, Waring AJ, Lehrer RI, Kaznessis YN. Correlation between simulated physicochemical properties and hemolycity of protegrin-like antimicrobial peptides: predicting experimental toxicity. *Peptides* 2008; 29:1085-93.

Selected Conference Posters and Presentations

1. **Schuster BS**, Dignon G, Jahnke C, Good MC, Hammer DA, Mittal J. "Sequence Determinants of Protein Phase Separation of the Intrinsically Disordered RGG Domain from LAF-1." Biophysical Society 63rd Annual Meeting, Baltimore, MD. March 6, 2019. (Presentation)
2. **Schuster BS**, Reed EH, Jahnke C, Ramage H, Good MC, Hammer DA. "Synthetic Organelles Engineered from Phase-Separating Proteins." 2018 AIChE Annual Meeting, Pittsburgh, PA. October 31, 2018. (Presentation)

3. **Schuster BS**, Reed EH, Jahnke C, Good MC, Hammer DA. "Controllable phase separation and modular recruitment to investigate biochemical compartmentalization in membraneless organelles." Biophysical Society 62nd Annual Meeting, San Francisco, CA. February 18, 2018. (Poster)
4. **Schuster BS**, Reed EH, Jahnke C, Good MC, Hammer DA. "Controllable phase separation and modular recruitment to form synthetic membraneless organelles." ASCB-EMBO 2017 Meeting, Philadelphia, PA. December 3, 2017. (Poster)
5. **Schuster BS**, Reed EH, Good MC, Hammer DA. "Protease-responsive droplets engineered from self-assembled disordered proteins." 2017 AIChE Annual Meeting, Minneapolis, MN. November 2, 2017. (Presentation)
6. **Schuster BS**, Hammer DA. "Protease-responsive microspheres engineered from self-assembled disordered proteins." 254th ACS National Meeting, Washington, DC. August, 22, 2017. (Presentation)
7. **Schuster BS**, Parthasarathy P, Reed E, Hammer DA. "Engineering protease-triggered disassembly of intrinsically disordered protein droplets." Biophysical Society 61st Annual Meeting, New Orleans, LA. February 13, 2017. (Poster)
8. **Schuster BS**, Parthasarathy P, Reed E, Hammer DA. "Engineering protease-responsive protein microspheres from self-assembled disordered proteins." 15th Annual Biomedical Postdoctoral Research Symposium, Philadelphia, PA. November 1, 2016. (Presentation)
9. **Schuster BS**, Parthasarathy P, Reed E, Hammer DA. "Engineering protease-responsive protein microspheres from self-assembled disordered proteins." Biomedical Engineering Society Annual Meeting, Minneapolis, MN. October 6, 2016. (Presentation)
10. Kays JC, **Schuster BS**, Allan DB, Hanes J, Leheny R. "Multiscale diffusion measurements in biological gels using photoactivatable fluorescent nanoparticles." Biophysical Society 59th Annual Meeting, Baltimore, MD. February 8, 2015. (Poster)
11. **Schuster BS**. "Probing and overcoming extracellular barriers to inhaled nanomedicine." Johns Hopkins Cystic Fibrosis Seminar, Baltimore, MD. May 6, 2014. (Presentation)
12. **Schuster BS**, Kim AJ, Kays JC, Kanzawa MM, Suk JS, Hanes J. "The cystic fibrosis sputum barrier to adeno-associated virus gene therapy." 12th Annual US-Japan Symposium on Drug Delivery Systems, Lahaina, Maui, Hawaii. December 18, 2013. (Poster and Invited Presentation)
13. Birket S, Chu KK, Li Y, Houser GH, Mazur M, **Schuster BS**, Hanes, J, Tearney GJ, Rowe SM. "The relationship between periciliary liquid hydration and mucus transport is affected by bicarbonate transport." 27th Annual North American Cystic Fibrosis Conference. Salt Lake City, UT. October 18, 2013. (Poster)
14. Donaldson SH, Zeman K, Laube B, Corcoran T, Locke L, Pilewski J, Hanes J, **Schuster B**, Kanzawa M, Rowe SM, Bennett WD. "Effect of Ivacaftor on mucociliary clearance and mucus rheology in patients with a G551D CFTR mutation." 27th Annual North American Cystic Fibrosis Conference. Salt Lake City, UT. October 18, 2013. (Poster)
15. **Schuster BS**, Suk JS, Woodworth GW, Hanes J. "Nanoparticle diffusion in human respiratory mucus." Biomedical Engineering Society Annual Conference, Atlanta, GA. October 26, 2012. (Presentation)

Teaching and Mentoring

Course Instructor, Rutgers University

Biological Foundations of Chemical Engineering (110 students)	Spring 2020
Biochemical Engineering (co-taught with Haoran Zhang; 76 students)	Fall 2019
Biological Foundations of Chemical Engineering (89 students)	Spring 2019

Research Mentorship, Rutgers University

Ph.D. Students: Fleurie Kelley, Xinyi Li
Masters Students: Aishwarya Kanchi Ranganath, Rashmi Vasthare
Undergraduate Students: Ashley Huang, Amelia Rucki, Maxwell Shapiro, Kaleb Friedman