Imperial College London
Kevin Freedman

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

A. RESEARCH INTERESTS

Single molecule science and kinetics, DNA sequencing, pathogenesis and diagnostics, nanotechnology and nanometrology, single molecule trapping and manipulation, DNA machines, biomimetics and (bio)nanomaterials, microfluidic devices, simultaneous optical and electrical measurements, single molecule FRET, nanophotonics, nanoplasmonics.

B. ACADEMIC APPOINTMENTS

- Post-Doctoral Research Associate- Imperial College London
  - March 2014 - June 2015
- Post-Doctoral Research Associate- Drexel University
  - December 2013 - February 2014

C. EDUCATION

Drexel University, Department of Chemical and Biological Engineering
Philadelphia, PA
M.S. in Chemical and Biological Engineering
Ph.D. in Chemical and Biological Engineering
Completed in: December 2013

Dissertation Title: *Single Molecule Protein Biophysics Studied Using Solid-State Nanopores*
Adviser: *MinJun Kim*

Drexel University, School of Biomedical Engineering, Science, and Health Systems
Philadelphia, PA
B.S. in Biomedical Engineering (magna cum laude, GPA: 3.8 out of 4.0)
M.S. in Biomedical Engineering (GPA: 4.0 out of 4.0)
Completed in: June 2009

D. AWARDS AND HONORS

+ **Awarded "Doctoral Student with the Most Promise" Award by the Office of Graduate Studies (Drexel University)**
  - 2 awards presented out of 258 doctoral students
+ **Awarded and accepted the Whitaker Fellowship through the Institute of International Education**
  - 20% success rate at the national level
+ Featured on the front cover of the Journal *Small (Impact Factor: 7.8)*
+ Centralized Research Facility Image Award (Transmission electron microscopy Imaging Award)
+ **Awarded NSF Graduate Research Fellowship (2010-2013)**
  - 13-18% success rate at the national level
+ **Awarded NSF IGERT Fellowship (2009)**
  - 10% success rate at the national level
+ 2nd Place in the "Green to Gold Concepts to Change the World: People, Prosperity & Planet" awarded by the Baiada Center.
+ Best Paper Award at ASME IMECE 2009
+ Best Poster Award in Computational Biology (Research Day 2009)

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

D. AWARDS AND HONORS (Continued)

+ Outstanding Poster Award in Drexel University's College of Medicine Discovery Day (2008)
+ Dean's List
+ Tau Beta Pi National Honors Society Invitation-awarded to top 5% of students in all engineering fields
+ KTE National Honors Society Invitation
+ Fiserv 20th Anniversary Scholarship, 2008 (Awarded to outstanding students for academic achievement)
+ 1st place in the Freshmen Engineering Design Competition

E. WORK AND RESEARCH EXPERIENCE

The Edel Group, Chemical Physics Section, Imperial College London
Post-Doctoral Fellow-Whitaker Grantee

+ Fabricated hybrid microchannel-nanopore devices with DNA trapping capability.
+ Characterized the trapping of molecules and nanoparticles using dielectrophoresis
+ Collected and analyzed single molecule FRET data using custom MATLAB and LABVIEW programs and used Gold NanoWell Structures for FRET enhancement
+ Characterized SERS enhancement at the tip of a nanopipette
+ Fabricated next generation graphene sensors using Helium beam patterning

The Kim Research Group, Mechanical Engineering, Drexel University
Ph.D. Student (2009-2013), Protein Biophysics using Nanopores (Dr. MinJun Kim)

+ Protein domain folding kinetics using solid-state nanopores
+ Detection of single point mutations in proteins
+ HIV diagnostics and antigen unbinding within a nanopore
+ Development and experimental design of graphene nanopores for DNA analysis
+ Fabrication of graphene pores with polyhedral crystals at the pore edge
+ TEM and TEM Tomography for nanopore sculpting and design
+ TEM imaging and analysis of gold nanorods, bacteria, nanotubes, and nanopores

The Moxon NeuroEngineering Laboratory, Biomedical Engineering, Drexel University
Master's Student (2007-2009), Epilepsy, Seizure Detection and Prediction (Dr. Karen Moxon)

+ Translational Device Development: Closed Loop Deep Brain Stimulation Device to Predict and Prevent Seizures
+ Neurological in-vivo experimentation and computational analysis
+ Seizure detection algorithm design using support vector machine classification
+ Implementation and optimization of multiple signal processing algorithms (wavelet entropy, autocorrelation, fractal exponent, variance, mobility)
+ Design of novel seizure detecting measurements (phasejumps, autocorrelation-entropy, slope index)
+ Neural signal analysis toolbox development and GUI design (MATLAB)

Computational Modeling Research, Biomedical Engineering, Drexel University
Research Assistant (2008-2009), Biological Rhythms (Dr. Donald McEachron)

+ Development of models and simulations for book entitled, "Chronobioengineering: Introduction to Biological Rhythms with Applications"
+ Neuro-endocrine modeling, brain rhythm modeling

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

Mondialogo Engineering Award Competition Research, Biomedical Engineering, Drexel University
Research/Volunteer Engineer (2008-2009), Jaundice Phototherapy Device Design (Dr. Rosen)

+ Translational Device Development of a low cost phototherapy device for under-developed countries
+ Optimize original patent design to increase efficiency and safety of LED array circuit

Merck and Co, Inc, RNA Therapeutics, West Point, PA
Research Scientist (Sept. 2006- Mar. 2008), In vitro and in vivo Molecular Biology

+ Transfection and assay optimization/trouble shooting
+ RNA and protein isolation, purification, and quantification
+ Targeted drug delivery and bio-distribution testing (pharmacokinetics and pharmacodynamics)
+ Collected data used to make go/no-go decisions about potential licensing contracts
+ Protocol development and validation for testing siRNA formulations

Arkema Inc, Altuglas Department, King of Prussia, PA
Research Engineer (Sept. 2005-Mar. 2006), Polymer Mechanics and Chemistry

+ Tensile, tear, dynatup/impact, hardness, chemical resistance, heat tolerance, and melt flow testing
+ Extrusion line controller and injection molding experience
+ Performed experimental design, requesting and procuring material, blending, extrusion, injection molding, sample preparation, testing, analysis, and technical report writing.
+ Design of Plexiglas objects for showcasing at conferences

F. BOOK CHAPTERS

1. G. Goyal, **K. Freedman**, A.S. Prabhu, M.J. Kim, "Case Studies Using Solid State Pores," in Engineered Nanopores for Bioanalytical Applications, Ed. J.B. Edel and T. Albrecht, Elsevier, 2013.
2. **K. Freedman**, D. Grasse, K. Moxon. Seizure detection using a novel multi-measurement support vector machine algorithm, Lap Lambert Publishing, 2009.
3. Acknowledged in the following: Chronobioengineering: Introduction to Biological Rhythms with Applications, Morgan and Claypool Publishers, 2012

G. PUBLICATION LIST

1. **K. Freedman***, S. R. Haq, J.B. Edel, P. Jemth, M.J. Kim*, "Nonequilibrium Capture Rates Induce Protein Accumulation and Enhanced Adsorption to Solid-State Nanopores," *ACS Nano,* 8 (12), 12238–12249 (2014). * Co-Corresponding Author
2. A. Rutkowska, **K. Freedman**, J. Skalkowska, M.J. Kim, J.B. Edel, and T. Albrecht, 2015, "3D characterization, electrodeposition and bipolar electrode effects in metallized solid-state nanopores and their use in the detection of insulin," *Analytical Chemistry*, accepted.
3. A.R. Bastian, et al., "Mechanism of Multivalent Nanoparticle Encounter with HIV-1 for Potency Enhancement of Peptide Triazole Inactivators," *Journal of Biological Chemistry*, 290(1), 529-543 (2014).

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

4. A.P. Ivanov, **K. Freedman**, Min Jun Kim, T. Albrecht, J.B. Edel, "High precision fabrication and positioning of nanoelectrodes in a nanopore," *ACS Nano*, 8 (2), 1940–1948 (2014).
5. **K. Freedman**, C.W. Ahn, M.J. Kim, "Detection of long and short DNA using nanopores with graphitic polyhedral edges," *ACS Nano*, 7(6), 5008-5016 (2013).
6. G. Goyal, **K. Freedman**, M.J. Kim, "Gold nanoparticle translocation dynamics and electrical detection of single particle diffusion using solid state nanopores," *Analytical Chemistry*, 85(17), 8180-8187 (2013).
7. A.R. Bastian, M. Contarino, F. Kantharaju, D. Moreira, **K. Freedman**, K. McFadden, C. Duffy, J. Jacobson, J. Hoxie, and I. Chaiken, "Molecular and Functional Transitions in the Virolytic Breakdown of HIV-1 by Sulfhydryl Peptide Triazole," *Retrovirology*, 10,153 (2013).
8. D. Japrung, J. Dogan, **K. Freedman**, A. Nadzeyka, S. Bauerdick, T. Albrecht, Min Jun Kim, P. Jemth, J. Edel, "Single molecule studies of intrinsically disordered proteins using solid-state nanopores," *Analytical Chemistry*, Vol. 85, No.4, p2449-2456 (2013).
9. **K. Freedman**, S. R. Haq, J.B. Edel, P. Jemth, M.J. Kim, "Controlled unfolding and stretching of a protein domain inside a solid-state nanopore," *Nature Scientific Reports*, Vol. 3, 1638 (2013).
10. **K. Freedman**, A. Bastian, I. Chaiken, M.J. Kim, "Solid-state nanopore detection of antibody-antigen complexes: a HIV model study," *Small*, 9(5), 750-759 (2013).
Selected for the front cover of Small
11. G. Goyal, **K. Freedman**, A.S. Prabhu, M.J. Kim, "Case studies using solid state pores," in Engineered Nanopores for Bioanalytical Applications, Ed. J.B. Edel and T. Albrecht, Elsevier, 2013.
12. W. Jo, **K. Freedman**, D.K. Yi, M.J. Kim, "Fabrication of tunable silica-mineralized nanotubes using flagella as bio-templates," *Nanotechnology*, Vol. 23, 055601 (2012).
13. A.S. Prabhu, **K. Freedman**, J.W.F. Robertson, Z. Nikolov, J.J. Kasianowicz, M.J. Kim, "SEM-induced shrinking of solid-state nanopores for single molecule detection," *Nanotechnology*, Vol. 22, 425302 (2011).
14. W. Jo, **K. Freedman**, D.K. Yi, R.K. Bose, K.K.S. Lau, S.D. Solomon, Min Jun Kim, "Photon to thermal response of single patterned gold nanorods cluster under near infrared laser irradiation," *Biofabrication*, Vol. 3, 015002 (2011).
15. W. Jo, **K. Freedman**, Min Jun Kim, "Metallization of biologically inspired silica nanotubes," *Materials Science and Engineering: C*, 32(8), 2426-2430 (2012).
16. **K. Freedman**, M. Jurgens, A. Prabhu, C.W. Ahn, P. Jemth, J. Edel, M.J. Kim, "Chemical, thermal, and electric field induced unfolding of single protein molecules studied using nanopores," *Analytical Chemistry*, Vol. 83, 5137-5144 (2011).
17. A. Prabhu, T. Jubery, **K. Freedman**, R. Mulero, P. Dutta, M. Kim. Chemically modified solid-state nanopores for high throughput nanoparticle separation. *Condensed Matter*, 22 ,454107 (2010).
18. R. Mulero, A. Prabhu, **K. Freedman**, M. Kim, Nanopore Based Devices for Bioanalytical Applications, *Journal of the Association for Laboratory Automation*, 15(3): 243-252 (2010).
19. W. Hesse, **K. Freedman**, M.J. Kim. The importance of bacterial nanofluidics on medicine and engineering. *Small*, 6(8), 895-909 (2010).

Imperial College London
Kevin Freedman

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

IN PREPARATION:

1. **K. Freedman**, A. Ivanov, S.H. Oh, J. Edel. "Trapping Molecules Within Nanofluidic Devices "
2. **K. Freedman**, A. Ivanov, S.H. Oh, J. Edel. "Gold Nanoparticle-Enhanced SERS using Dielectrophoresis"

H. CONFERENCE PRESENTATIONS AND POSTER PRESENTATIONS

Platform Speaker: American Chemical Society Spring Meeting (New Orleans, 2013), 56th Annual Biophysical Society Conference (San Diego, 2012), Nanopore Conference (Spain, 2012), Asia Nano Camp Meeting (S. Korea, 2011), IEEE SENSORS (Hawaii, 2010) *Full Length Conference Paper

Paper Acceptance: ASME International Mechanical Engineering Conference (2009), The 38th Annual Northeast Bioengineering Conference, The US-Korea Conference on Science, Technology, and Entrepreneurship (Park City, UT), The US-Korea Conference on Science, Technology, and Entrepreneurship (Seatle, WA), NSF IGERT Project Meeting (Washington DC), World Academy of Science, Engineering and Technology's International Conference on Behavioral, Cognitive, Educational and Psychological Sciences (2009), Neuroscience Conference (2009), Drexel University Biomedical Engineering Entrepreneur and Technical Showcase (2009), Northeastern Bioengineering Conference (2008), Drexel University Research Day (2008).

I. TEACHING EXPERIENCE

MEM 517/800: Nanometrology and MEM 518: Nanomanufacturing, Guest Lecturer
Duration: 3 years

+ Taught classes (approximately 2 hours) on the history, working principles, and practical skills needed to use a transmission electron microscope.
+ Designed, and taught, a lab session on how to use a transmission electron microscope.
+ Lab session exercises included sample preparation of gold nanoparticles, concepts of over-focus, in-focus, and under-focus in the TEM, imaging of gold nanoparticles, and elemental composition analysis using EDX.
+ Lab reports were graded based on prior directions including (1) identifying images with varying levels of focus, (2) using imagej to create a histogram of particle diameters, (3) analyzing and describing EDX results in terms of inelastic and elastic electron scattering.

MEM 517/800: Nanometrology and MEM 518: Nanomanufacturing, Lead TA
Duration: 2 years

+ Maintained teaching responsibilities, as described above.
+ Designed and modified lab sessions to accommodate variable samples.
+ Responsible for grading labs and the Final Project which students presented to me on the last day of class (Final project grades were given based on a rubric).

Student Oversight

- Zainab Chachia, Imperial College London, BSc
- Lucy Rowlands, Imperial College London, BSc, Summer Student
- Senior Design Group (Amit Deka - Biomedical Engineering, Xuan Eao - Biomedical Engineering, Nick Sloms - Electrical Engineering, Aniruddha Sengupta - Electrical Engineering)

Post-Doctoral Research Associate
Whitaker Fellow @ Imperial College London
Bioengineering and Chemical Physics
k.freedman@imperial.ac.uk

- Senior Design Group (Marianne Cristobal-Biomedical Engineering, Sarah C. DeLeon-Biomedical Engineering, Rohan Desai-Biomedical Engineering, Enos Heaps-Biomedical Engineering)
- Chrissy Gieder, BS, Drexel University, Mechanical Engineering
- Gloria Kim, Professional Intern

Private Tutoring: Differential Equations, Molecular Biology, Physics II, Chemistry

J. INTERNATIONAL VISITING SCHOLAR POSITIONS AND TRAINING

Uppsala University, Department of Medical Biochemistry and Microbiology (Uppsala, Sweden)

+ Performed protein expression, isolation, and purification using HPLC
+ Inserted single point mutations within a protein domain (PDZ2)
+ Conducted stability tests on the mutated proteins and compared to the wild type

KAIST, National Nanofabrication Center (Daejeon, South Korea)

+ Fabricated CVD graphene on a Si/Cu wafer
+ Optimized the transfer of graphene to a nanopores chip
+ Optimized the drilling of graphene using a transmission electron microscope

Imperial College London, Chemistry Department (London, United Kingdom)

+ Trained other graduate students on how to use graphene for biosensing
+ Developed novel graphene biosensors and nanopores devices

K. LEADERSHIP POSITIONS & CERTIFICATIONS

+ Drexel University's Graduate Student Association, Executive Board Member, 2012-2013
+ Drexel Alumni Grant Committee, Board Member, Graduate Student Representative, 2012-2013
+ Teaching Portfolio Certificate Program, certified and completed in 2012
+ International Teaching Assistant Mentor, 2012
+ Fulbright Summer Mentor Program, 2012
+ Drexel Biomedical Engineering Undergraduate Association, Vice President, 2008-2009
+ Drexel BMES, Secretary, 2007-2008

L. PROFESSIONAL SOCIETIES

+ American Chemical Society (ACS), 2012-present
+ Biophysical Society, 2011-2012
+ American Physics Society, 2009-present
+ National Biomedical Engineering Society, 2008-2009
+ Drexel KTE, a National Cooperative Education Honor Society