

# Rafael Mulero

Biological Actuation, Sensing, and Transport (BAST) Laboratory  
Department of Mechanical Engineering and Mechanics  
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## Education

### Drexel University

Ph.D. in Mechanical Engineering

Expected Graduation Date: Summer 2010

Advisor: Professor MinJun Kim, Mechanical Engineering

B.Sc. in Mechanical Engineering

Philadelphia, PA  
(9/05~present)

(9/00~6/05)

## Awards

Koerner Family Fellowship for Doctoral Students Fellow (2009-2010)

National Science Foundation Nanoscale Science and Engineering Nanotechnology IGERT Fellow (2007-2009)

National Science Foundation Summer Institute on Energy Challenge and Nanotechnology Fellow (2008)

1st Place: Graduate oral research presentation competition, LSAMP Research Symposium and Mentoring Conference (2008)

George Law Academic Merit Fellowship (2007-2008)

National Science Foundation LSAMP Bridge to the Doctorate Fellow (2005-2007)

Drexel University Dean's Fellow (2005-2007)

## Publications-Refereed Journals

Mulero, R., Prahbu, A.S., Freedman, K., Kim, M.J., "Nanopore Based Devices for Bioanalytical Applications" Journal of the Association for Laboratory Automation, accepted for publishing 2010.

Hesse, W. R., Luo, L., Zhang, G., Mulero, R., Cho, J., Kim, M. J., "Mineralization of flagella for nanotube formation," Materials Science & Engineering C 2009, 29, 2282-2286.

Mulero, R., Lee, D. H., Kutzler, M. A., Jacobson, J. M., Kim, M. J., "Ultra-fast low concentration detection of Candida pathogens utilizing high resolution micropore chips," Sensors 2009, 9, 1590-1598.

Chansin, G.A.T., Mulero, R., Hong, J., Kim, M.J., deMello, A.J. and Edel, J.B., "Single-Molecule Spectroscopy Using Nanoporous Membranes", Nano Letters 2007, 7, 2901-2906.

Mulero, R., Layton, B., "Two-dimensional Minkowski sum optimization of ganged stamping blank layouts for use on pre-cut sheet metal for convex and concave parts", J Manuf Syst 2007, 26, 44-52.

## Book Chapters

Mulero, R. & Kim, M. J., "Design, Fabrication, and Applications of Solid-State Nanopores for Single Molecule Analysis", in Nanobiotechnology - A New Era of Modern Science, published by Stadium Press, LLC (Feb. 2008) invited.

## Conference Papers

Mulero, R., Hesse, W. R., Wu, L., and Kim, M. J., "Probing bacterial flagellar polymorphism in various fluidic environments using solid-state sub-micropores", Proc ASME International Mechanical Engineering Congress and Exposition, Boston, IMECE2008-66670, 2008.

Mulero, R., Lee, W., Myoung, J.-M., Kim, M. J., " Characterization of Isolated Flagella Tubes using Nanopore Sensors," Proc US-Korea Conference on Science, Technology, and Entrepreneurship , San Diego, 2008.

Prabhu, A. S., Moraga, A., Cecchini, M., Mulero, R., Olsen, S., Cho, Y. I. & Kim, Y. I., "Synthetic Nanoscale Architectures for Lipoprotein Separation" Proc ASME International Mechanical Engineering Congress and Exposition, Boston, IMECE2008-66670, 2008.

Mulero, R., Moraga, A., and Kim, M. J., "High Resolution Detection and Configuration of Bacteria using Microscale Pores", Proc ASME International Mechanical Engineering Congress and Exposition, Seattle, 2007.

Mulero, R., Lee, W., Myoung, J.-M., Kim, M. J., "Rapid Bacteria Detection and Configuration Using Solid-state Micro/Nanopore Sensors," The 18th International Symposium on Transport Phenomena, Daejeon, Korea, ISTP18-028, 2007.

Chansin, G.A.T., Mulero, R., Hong, J., Kim, M.J., deMello, A.J., Edel, J.B., "Toward Ultra-fast Parallel DNA Analysis: Sub-wavelength Metallic Nanopore Arrays for High-throughput Single Molecule Spectroscopy," Micro-TAS, Paris, France, 2007.

Kim, M. J., Mulero, R., Kim, C.-B., Hong, J., "Electron Beam Based Single-Digit Nanometer Pore Array Manufacturing for Single Molecule Analysis" ASME International Conference on Manufacturing Science & Engineering, Atlanta, MSEC2007-31007, 2007.

Zhou, J., Vas, A., Blackmore, D., and Mulero, R., "Fractal Geometry Based Model for a Musical Cymbal Design and Rapid Manufacturing", ASME International Conference on Manufacturing Science & Engineering, Atlanta, MSEC2007-31187 53, 2007.

## Patents

Kim, M. J., Mulero, R., Hesse, W.R., Cho, J., U.S Patent "Flagella as a Biological Material for Nanostructured Devices", pending, DXU-09-1050D, 2009

Kim, M. J., Mulero, R., Steager, E.B., U.S Patent "Nanopore Arrays and Sequencing Devices and Methods Thereof", pending, DXU-0132/06-0744D, 2007.

## Oral Presentations

Panel Discussion: "Men of Honor / Women of Distinction workshop" 12th Annual Philadelphia AMP Research Symposium and Mentoring Conference, October 17, 2009, Philadelphia, PA.

Panel Discussion: "Academics" HBCU STEM Fellowship Program Weekend Retreat, Educational Advancement Alliance Inc., July 11, 2009, Philadelphia, PA.

"Organic/Inorganic Nanopore & Analyte Detection" NSF UPenn/Drexel Nanotechnology IGERT Retreat, February 27, 2009, Shawnee on Delaware, PA.

"Electrochemical Sensing and Characterization of Submicro- to Micro-scale Organic and Inorganic Analyte Using Solid-state Nanopores" Single Molecule Biophysics World Networking Workshop, February 16, 2009, Drexel University, Philadelphia, PA.

“Research from Theory to Practice: Solid-State Pores and the Ionic Blockade Method” Congressman Fattah Conference on Higher Education, February 7, 2009, Philadelphia, PA.

“Probing bacterial flagellar polymorphism in various fluidic environments using solid-state sub-micropores”, Proc ASME International Mechanical Engineering Congress and Exposition, November 5, 2008, Boston, MA.

“Solid-State Nanopores and the Ionic Blockade Method” Roberto Clemente Middle School Career Day, October 23, 2008, Philadelphia, PA.

Poster Presentation: “Detection of Candida Using a Micro-scale Pore” Discovery Day 2008, October 15, 2008, Drexel University College of Medicine (Hahnemann), Philadelphia, PA.

“Solid state nanopores for single bio-molecule analysis” 11th Annual Philadelphia Louis Stokes Alliance for Minority Participation Research Symposium and Mentoring Conference, April 5, 2008, Philadelphia, PA. Awarded 1st Place in the graduate oral research presentation competition.

“Nanopores and the Ionic Blockade Method” Richmond Elementary School NSF RET alumni invite, October 19, 2007, Philadelphia, PA.

## **News in Media**

Biophotonics International, "Arrays of nanopores help detect individual molecular events en masse," November, 2007.

MedGadget, "Nanopore-based Single Molecule Spectroscopy," September 5, 2007.

Nanowerk, "Sucking nanospaghetti through nanopores," September 4, 2007.

## **Professional Affiliations**

American Society of Mechanical Engineers (ASME)

Louis Stokes Alliance for Minority Participation (LSAMP)

Society of Hispanic Professional Engineers (SHPE)

## **Professional Responsibilities & Services**

Conference Paper Review, 2009 ASME International Mechanical Engineering Congress and Exposition: Micro-Nano Fluidics (4 papers)

Journal Paper Review, Proceedings of the National Academy of Sciences of the United States of America (1 paper)

## **Courses Instructed**

Laboratory Instructor, MEM 435 Introduction to Computer Aided Design and Product Development Spring 10

Laboratory Instructor, ENGR 100 Beginning CAD for Design Fall 09

Substitute Lecturer, MEM 310 Thermodynamic Analysis I Spring 08 (3 lectures)