Crystal M. Han

Assistant Professor, Mechanical Engineering,
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EDUCATION

Stanford University, Stanford, CA 2011 – 2015
Ph.D., Mechanical Engineering
Advisor: Juan Santiago
Thesis title: Improvement of speed and sensitivity of DNA hybridization using isotachophoresis

Stanford University, Stanford, CA 2009 – 2011
M.S., Mechanical Engineering
Depth area: Fluid mechanics / Microfluidics / Electrokinetics

Korea Advanced Institute of Science and Technology (KAIST), South Korea 2005 – 2009
B.S., Mechanical Engineering

APPOINTMENTS

Assistant Professor, San Jose State University, San Jose, CA 2018 – present
Microfluidics group

- Directing a research group focused on control of transport and reaction of biomolecules by electric field in microfluidic systems.
- Developing microfluidic techniques applicable to rapid disease diagnosis, point-of-care diagnosis, food safety, and biomolecular research.
- Current projects: size-selective purification of RNA for small input ribosome profiling, continuous bacteria detection from aqueous solution, study of efficiency of ITP-based DNA extraction method, and on-chip polymerase chain reaction (PCR)
- Teaching undergraduate and graduate courses related to thermal-fluid area including Fluid mechanics (ME111), Heat transfer (ME114), and Viscous flow analysis and computation (ME221).

Postdoctoral Researcher, National Institute of Standards and Technology, MD 2015 – 2017
Genome-scale measurement group

- Developed microfluidic size-selective RNA purification and enrichment technique aiming to measure the active translation of mRNA
- Integrated the microfluidic technique with enzymatic sample processing to enable rapid ribosome footprint purification from low sample input

Part Time Faculty, Foothill College, CA Winter, Spring 2015

- Worked at PSME center (Physical Sciences, Mathematics, and Engineering center) tutoring students from 18 math, science, and engineering courses in Winter quarter
- Lectured 4-unit "ENGR 6: Engineering Graphics" class (size of 20 students) in Spring quarter to cover engineering drawing, modeling with Solidworks, and 3D printer-based rapid prototyping.

HONORS AND AWARDS

- NIST National Research Council (NRC) Postdoctoral Research Associateship. 2015 – 2017
- Stanford graduate fellowship (SGF) 2009 – 2013
- Samsung SDS fellowship 2005 – 2009
  Nation-wide competition for full tuition and stipend for undergraduate education in Korea
- KAIST ME Department scholarship 2006 – 2009
- Outstanding Achievement *Cum laude* Award from KAIST ME Department 2006
  Awarded to the highest achievement student among class of 2009 ME students

PEER-REVIEWED JOURNAL PUBLICATIONS (* Equal Contribution)

1. Khnouf R., **Han C.M.**, **"**Isotachophoresis-Enhanced Immunoassays, Challenges and Opportunities", IEEE Nanotechnology Magazine, 2020 (accepted)
2. Khnouf R., **Han C.M.,** Munro S.A., "Isolation of enriched small RNA from cell-lysate using on-chip isotachophoresis," 40 (23-24), 3140-3147, Electrophoresis, 2019
3. **Han C.M.,** Catoe D., Munro S.A., Khnouf R., Santiago J.G., Snyder M.P., Salit M.L., Cenik C., "Simultaneous RNA purification and size selection using an on-chip isotachophoresis with ionic spacer,"19, 2741–2749, Lab Chip, 2019
4. Khnouf R., Shore S., **Han C.M.,** Henderson J., Munro S., McCaffrey A., Shintaku H., Santiago J.G., "Single-Cell Sequencing for Small RNA Using Modified Adapters," 90, 12609-12615, Analytical Chemistry, 2018
5. Cao Y., Hjort M., Chen H., Birey F., Leal-Ortiz S., **Han C.M.,** Santiago J.G., Pasca S.P., Wu J., Melosh N.A., "Non-Destructive Nanostraw Intracellular Sampling for Longitudinal Cell Monitoring," 114 (10): E1866-E1874, Proceedings of the National Academy of Sciences (PNAS), 2017
6. **Han C. M.**, Katilius E., and Santiago J.G., "Increasing hybridization rate and sensitivity of DNA microarrays using Isotachophoresis," 14 (16), 2958-2967, Lab on a Chip, 2014
7. Bahga S.S.,***** **Han C.M.**,***** and Santiago J.G., "Integration of rapid DNA hybridization and capillary zone electrophoresis using bidirectional isotachophoresis," 138, pp. 87-90, Analyst, 2013
8. Bercovici M.,***** **Han C.M.**,***** Liao J.C., and Santiago J.G., "Rapid Hybridization of Nucleic Acids Using Isotachophoresis," 109, 28, pp. 11127-11132, Proceedings of the National Academy of Sciences (PNAS), 2012
9. Marshall L.A., **Han C.M.**, and Santiago J.G., "Extraction of DNA from Malaria-Infected Erythrocytes Using Isotachophoresis", 83, 24, pp. 9715-9718, Analytical Chemistry, 2011
10. Bercovici M., Kaigala G.V., Mach K.E., **Han C.M.**, Liao J.C., and Santiago J.G., "Rapid detection of urinary tract infections using isotachophoresis and molecular beacons," 83, 11, pp. 4110-4117, Analytical Chemistry, 2011

CONFERENCE PRESENTATIONS

Oral Presentations

1. "15 hour DNA microarrays in 30 minutes with 8X higher sensitivity," 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2014), San Antonio, Texas, October 28, 2014
2. "Integration of rapid DNA hybridization and capillary zone electrophoresis," 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2012), Okinawa, Japan, Oct. 30, 2012
3. "Rapid DNA hybridization using isotachophoresis," 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2011), Seattle, Washington, October 4, 2011

Poster Presentations

1. Klar, G., Rosales, N., Rosenfeld, L., **Han C.M.,** "Development of a microfluidic approach for rapid and continuous detection of pathogens in food and water samples," The 32nd Annual CSU Biotechnology Symposium, Santa Clara, CA, January 16-18, 2020
2. Khnouf R., **Han C.M.,** Munro S.A., Santiago J.G., "Small RNA Extraction and Purification from Bulk Cell Lysate using Isotachophoresis," The 9th international conference on Microtechnologies in Medicine and Biology (MMB 2018), Monterey, California, Mar. 26-28, 2018
3. **Han, C.M.**, A. Munro, S.A., Shintaku, H., Zagarra, F.V., Santiago, J.G., Salit, M., "Rapid extraction of ribosome footprints from a single cell for genome-wide ribosome profiling," Lab-on-a-Chip, Microfluidics & Microarrays World Congress 2016, San Diego, CA, 26 September 26 - September 28, 2016

4. **Han, C.M.**, A. Munro, S.A., Shintaku, H., Zagarra, F.V., Santiago, J.G., Salit, M., "Rapid extraction of ribosome footprints from a single cell for genome-wide ribosome profiling," Stanford Genetics Retreat 2016, Monterey, CA, September 21-23, 2016
5. **Han, C.M.**, Bercovici, M., Bahga, S.S., Katilius, E., Santiago, and Santiago, J.G., "Rapid and sensitive DNA hybridization by isotachophoresis," NIST Sigma Xi Postdoc Poster Presentation, Gaithersburg, MD, February 19, 2016
6. **Han, C.M.**,* Bahga, S.S.,* Santiago, J.G., "Integration of rapid DNA hybridization and capillary zone electrophoresis," BioX Interdisciplinary Initiatives Symposium, Stanford, CA, February 25, 2013
7. **Han, C.M.,** Bercovici, M., Marshall, L.A., Garcia-Schwarz, G., Persat, A., Liao, J.C., and Santiago J.G., "Isotachophoresis for extraction and rapid hybridization of nucleic acids," the International Symposium, Exhibit & Workshop on Electro- and Liquid Phase-Separation Techniques, ITP 2012, Baltimore, MD, September 30 – October 3, 2012
8. **Han, C.M.**,* Bercovici M.,* Liao, J.C., and Santiago, J.G., "Nucleic acid hybridization speed-up using isotachophoresis," Biomechanical Engineering Conference at Stanford (BMECS), Stanford, CA, May 22, 2012
9. Bercovici M.,* **Han C.M.**,* Santiago J.G., and Liao J.C., "Rapid DNA hybridization using isotachophoreis", Gordon Research Conference on Physics and Chemistry of Microfluidics, Waterville Valley, NH, June 26 – July 1, 2011
10. Bercovici M., Kaigala G.V., Mach K.E., **Han C.M.**, Liao J.C., and Santiago J.G., "Rapid detection of urinary tract infections using isotachophoresis and molecular beacons", Gordon Research Conference on Physics and Chemistry of Microfluidics, Waterville Valley, NH, June 26 – July 1, 2011
11. Bercovici, M.,* **C.M. Han**,* J.G. Santiago, "Rapid DNA hybridization using isotachophoresis", BioX Interdisciplinary Initiatives Symposium, Stanford, CA, Mar. 11, 2011
12. Bercovici M., Kaigala G.V., **Han C.M.**, Mach K.E., Liao J.C., and Santiago J.G., "Rapid detection of urinary tract infections using isotachophoresis and molecular beacons", The Thermal and Fluid Sciences Affiliates and Sponsors Conference (TFSA 2011), Stanford, CA, Feb. 2 – 4, 2011
13. Marshall, L.A., Wu, L., **Han, C.M.**, Bachman, M. and Santiago, J.G., "On-Chip Lysis and ITP Extraction of Malarial DNA using Printed Circuit Board Devices," Micro/Nano Fluidics Fundamentals Focus Center Conference, Washington, DC, Dec. 14, 2010

REFERENCED CONFERENCE PROCEEDINGS

1. **Han C.M.**, Katilius E., and Santiago J.G., "15 hour DNA microarrays in 30 mins with 8X higher sensitivity," Proceedings of the 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2014), San Antonio, Texas, Oct. 26 – 30, 2014
2. **Han C.M.**,* Bahga S.S.,* Santiago J.G., "Rapid Southern-Blot-Type Assays Using Bidirectional Isotachophoresis," Proceedings of the 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2012), Okinawa, Japan, Oct. 28 – Nov. 1, 2012
3. Bercovici M.,* **Han C.M.**,* Liao, J.C., Santiago J.G., "Rapid DNA Hybridization Using Isotachophresis," Proceedings of the 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2011), Seattle, Washington, Oct. 2 – 6, 2011
4. Marshall L.A., Wu L.L., **Han C.M.**, Bachman M., Santiago J.G., "On-Chip Integration of Lysis and Nucleic Acid Preparation of Malaria-Infected Blood," Proceedings of the 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2011), Seattle, Washington, Oct. 2 – 6, 2011
5. Wu L.L., Marshall L.A., Babikian S., **Han C.M.**, Santiago J.G., Bachman M., "A Printed Circuit Board Based Microfluidic System for Point-of-Care Diagnostic Applications," Proceedings of the 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS2011), Seattle, Washington, Oct. 2 – 6, 2011
6. Wu L.L., Marshall L.A., **Han C.M.**, Santiago, J.G., and Bachman, M. "Integrated Microfluidics on Printed Circuit Boards, and an Application for Point of Care Diagnostics," IEEE Transducers, June 5 – 9, 2011

OTHER PRESENTATIONS

- Tapas Talks - Engineering and Science, "Development of on-chip techniques for purification and size selection of RNA," Nov. 2019

PROFESSIONAL SERVICE

- Reviewer for Biomedical Microdevices — Feb 2019
- Reviewer for Analytical Methods — July 2019

DEPARTMENTAL, COLLEGE, UNIVERSITY SERVICE

- Designated Faculty Advisor for undergraduates, College of Engineering — Fall 2019 – present
- Chair, Graduate Studies Committee, Department of Mechanical Engineering — Fall 2018 – present
- Member, Scholarship Committee, Department of Mechanical Engineering — Fall 2019 - present
- Member, Graduate Studies Committee, College of Engineering — 2018 - 2019
- Member, Graduate Studies Committee, Department of Mechanical Engineering — 2018

PATENTS

- US 14/630,623 (2015) Devices and methods for controlling reversible chemical reactions at solid-liquid interfaces by rapid preconcentration and phase replacement