Mechanical Engineering

Qiao Lin
PROFESSOR OF MECHANICAL ENGINEERING

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Qiao Lin's research addresses biological and medical applications of microelectromechanical systems (MEMS), with an emphasis on using MEMS and microfluidic technologies to create integrated devices and systems for micro- and nanoscale biological sensing and manipulation. These devices and systems aim to allow sensitive and accurate interrogation of biomolecules and cells in well-controlled micro- and nanoscale environments, thereby enabling, in a manner unattainable with conventional methods, new insights into fundamental biological phenomena as well as innovative capabilities for practical biomedical applications.

Lin's specific research thrusts involve micro- and nanoscale biosensing, aptameric microfluidics, and microfluidic biomolecular and cellular manipulation. Efforts in micro- and nanobiosensing address glucose sensing, biocalorimetry, and nanobiosensing. In glucose sensing, subcutaneously implantable MEMS sensors are created to measure glucose binding-induced changes in the physical properties of functional polymers for accurate and reliable continuous glucose monitoring in diabetes care. Biocalorimetry focuses on developing MEMS devices to directly measure and characterize thermal activities in biological reactions and interactions with reduced cost, higher efficiency and reduced material consumption. Nanobiosensing exploits biologically functionalized nanomaterials to enable specific and sensitive biomolecular detection in physiological media. Research in aptameric microfluidics explores the use of aptamers (affinity oligonucleotides) for biosensing and manipulation, and addresses the integrated and rapid discovery of aptamers (from randomized oligonucleotides) as personalized reagents in clinical diagnostics and therapeutics. Finally, efforts in microfluidic biomolecular and cellular manipulation involve the selective isolation and enrichment, nondestructive and flexible recovery, and label-free detection of biomolecules and cells using aptamer-based affinity methods or physically based designs. Microfluidic systems are also developed to facilitate biodosimetry via integrated manipulation and gene expression analysis of ionizing beam-irradiated single cells.

Lin received a BS in engineering mechanics from Tsinghua University in 1985 and a PhD in mechanical engineering from the California Institute of Technology in 1998.

RESEARCH INTERESTS
Microelectromechanical systems (MEMS), microfluidics and nanofluidics, micro- and nanobiosensing, and biomolecular nanotechnology

RESEARCH AREAS
Sensing, devices, modeling, and nanoscience

LINKS
CV N/A LAB WEBSITE

RESEARCH EXPERIENCE
- Postdoctoral scholar, California Institute of Technology, 1998-2000

PROFESSIONAL EXPERIENCE
- Professor of mechanical engineering (with tenure), Columbia University, 2018-
- Associate professor of mechanical engineering (with tenure), Columbia University, 2010-2018
- Associate professor of mechanical engineering (without tenure), Columbia University, 2005–2010
- Assistant professor of mechanical engineering, Carnegie Mellon University, 2000–2005
- Assistant professor of biomedical engineering (by courtesy), Carnegie Mellon University, 2003–2005

PROFESSIONAL AFFILIATIONS
- American Society of Mechanical Engineers (ASME)
- Institute of Electrical and Electronics Engineers (IEEE)

SELECTED PUBLICATIONS

- Z. Hao, Y. Pan, W. Shao, Q. Lin, and X. Zhao, "Graphene-based fully integrated portable nanosensing system for on-line detection of cytokine biomarkers in saliva," *Biosensors and Bioelectronics*, 134: 16-23, 2019.
- Y. Li, Y. Zhu, C. Wang, M. He, Q. Lin, "Selective Detection of Water Pollutants Using A Differential Aptamer-Based Graphene Biosensor," *Biosensors and Bioelectronics*, 126 59-67, 2019.
- Z. Li, Y. Zhu, Y. Hao, M. Gao, M. Lu, A. Stein, A. A. Park, J. Hone, Q. Lin, and N. Yu, "Hybrid Metasurface-Based Mid-Infrared Biosensor for Simultaneous Quantification and Identification of Monolayer Protein," *ACS Photonics*, 6: 501-509, 2019.
- Z. Hao, Z. Wang, Y. Li, Y. Zhu, X. Wang, C. Moraes, Y. Pan, X. Zhao, and Q. Lin, "Measurement of cytokine biomarkers using an aptamer-based affinity graphene nanosensor on a flexible substrate toward wearable applications," *Nanoscale*, 10: 21681–21688, 2018.
- X. Wang, Y. Zhu, T. Olsen, N. Sun, W. Zhang, R. Pei and Q. Lin, "A Graphene Aptasensor for Biomarker Detection in Human Serum," *Electrochimica Acta*, 290: 356-363, 2018.
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- X. Feng, Z. Fu, Y. Jia, S. Kaledhonkar, B. Shah, A. Jin, Z. Liu, M. Sun, B. Chen, R. Grassucci, Y. Ren, H. Jian, J. Frank and Q. Lin. “A Fast and Effective Microfluidic Spraying-plunging Method for High-Resolution Single-Particle Cryo-EM,” *Structure*, 25: 663-670, 2017.
- Z. Hao, Y. Zhu, X. Wang, C. DiMarco, P. Rotti, S. Tyler, X. Zhao, J. Engelhardt, J. Hone and Q. Lin, “Real-Time Monitoring of Insulin Using a Graphene Field-Effect Transistor Aptameric Nanosensor,” *ACS Applied Materials & Interfaces*, 9:27504–27511, 2017.
- Y. Jia, Z. Zhang, B. Wang and Q. Lin, “A Polymer-based MEMS Isothermal Titration Calorimeter,” *Microfluidics and Nanofluidics*, 21:90, 2017.
- T. Olsen, Z. Zhang, R. Pei, M. Stojanovic and Q. Lin, “Integrated Microfluidic SELEX Using Free Solution Electrokinetics,” *Journal of the Electrochemical Society*, 164: B3122-B3129, 2017.
- T. Olsen, J. Zhu, J. Kim, R. Pei, M. Stojanovic, and Q. Lin, “An Integrated Microfluidic SELEX Approach Using Combined Electrokinetic and Hydrodynamic Manipulation,” *Journal of Laboratory Automation*, 22: 63-72, 2017.
- Z. Zhang, J. Shang, J. Yan, Q. Wang and Q. Lin*, “A Dielectric Affinity Glucose Microsensor Using Hydrogel-Functionalized Coplanar Electrodes,” Microfluidics and Nanofluidics, 21: 93-100, 2017.
- J. Kim, T. Olsen, J.P. Hilton, K. Yang, R. Pei, M. Stojanovic and Q. Lin, “Integrated Microfluidic Isolation of Aptamers Using Electrophoretic Oligonucleotide Manipulation," *Scientific Reports*, 6: 26139, 2016.
- B. Wang, Y. Jia and Q. Lin, “A Microfabrication-Based Approach to Quantitative Isothermal Titration Calorimetry," *Biosensors and Bioelectronics*, 78: 438-46, 2016.
- J. Yang, J. Zhu, R. Pei, J. Oliver, D. Landry, M. Stojanovic and Q. Lin, “An Integrated Microfluidic Aptasensor for Mass Spectrometric Detection of Vasopressin in Human Plasma Ultrafiltrate,” *Analytical Methods*, 8: 5190-5196, 2016. (Featured Cover Article)
- Y. Zhu, Y. Hao, E. Adogla, J. Yan, D. Li, K. Xu, Q. Wang, J. Hone and Q. Lin, “A Graphene-Based Affinity Nanosensor for Detection of Low-Charge and Low-Molecular-Weight Molecules,” *Nanoscale*, 8: 5815-5819, 2016.
- J. Hilton, T. Olsen, J. Kim, J. Zhu, T. Nguyen, M. Barbu, R. Pei, M. Stojanovic, and Q. Lin, "Isolation of thermally sensitive protein-binding oligonucleotides on a microchip," *Microfluidics and Nanofluidics*, 19, 795-804, 2015.
- C. Wang, J. Kim, J. Zhu, J. Yang, R. Pei, G. Liu, J. Hone, M. Stojanovic and Q. Lin, “A Graphene Nanosensor for Detection of Small Molecules," *Biosensors and Bioelectronics*, 71, 222-229, 2015.
- X. Huang, J. Oxsher, C. LeDuc, Y. Ravussin, Q. Wang, D. Accili, R. Leibel and Q. Lin, “A Microfabricated Differential Dielectric Affinity Biosensor,” *Lab on a Chip*, 14: 294-301, 2014. (Featured Cover Article)
- J. Zhu, T.H. Nguyen, R. Pei, M. Stojanovic and Q. Lin, “Specific Capture and Temperature Mediated Release of Cells Using Aptamer-Functionalized Microfluidic Surfaces,” *Lab on a Chip*, 12: 3504-13, 2012.