Yuqian (Evelyn) Zhang, Ph.D.

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Personal Profile

Highly motivated researcher with 8 years of experience in developing point-of-care (POC) biosensors, specializing in electrochemical impedance spectroscopy (EIS), for early disease diagnosis and prognosis. Proven track record of prototyping and optimizing innovative MEMS modalities using 3D modeling and finite element analysis simulations. Strong leadership skills and excel in collaborating within multi-disciplinary teams on various projects.

Core Competencies: electrochemical sensor; electrochemical impedance spectroscopy (EIS); digital microfluidics; electrokinetics; nanopore sensor; Finite element analysis (FEA).

Education

Ph.D in Electrical Engineering *Aug 2015 - Dec 2020*

University of Cincinnati *Cincinnati, OH, USA*

- GPA: 3.9/4.0; Graduate Student Engineer of the Month; University Graduate Scholarship

B.S. in Electrical Engineering *Sep 2011 - Jun 2015*

University of Electronic Science and Technology of China *Chengedu, Sichuan, China*

- GPA: 3.8/4.0; People's scholarship; Vice president in Student Union

Skills

Microfabrication	Photolithography, E-beam, sputtering, physical vapor deposition, profilometer, RIE, plasma cleaner, 3D printing
MEMS prototyping	Electrostatic, piezoelectric, opto-mechanic and magnetic devices, digital droplet, nanopore sensor
Molecular biology	Surface and bioconjugation chemistry, ELISA, PCR, UV/Vis Spectrophotometer, western blot, chromatography
Simulation	COMSOL Multiphysics, Multisim, LabVIEW
Structure Design	AutoCAD, Solidworks, Adobe Illustrator, Microsoft Visio
Programming	MATLAB, Python, R, SQL
Soft Skills	Communication, Time Management, Teamwork, Leadership, Independent thinking, Problem-solving, Presentation

Work Experience

Mayo Clinic *Rochester, MN, USA*

Research Fellow *Jan 2021 - present*

Electrochemical biosensor integrated with digital microfluidics (DMF) for point-of-care detection of protein and cell immunoassays

- Conceptualized and established an integrated DMF device configured with electrochemical biosensor to achieve the extraction and detection of circulating biomarkers in a rapid and automated manner
- Created and implemented experimental strategies to enhance the functionality and modification of sensor surfaces by forming a self-assembled monolayer (SAM) at the gold electrode surface, facilitating the integration of bioassays for improved sensor performance
- Optimized the design formats of interdigitated electrode (IDE) assay for 3X enhanced sensitivity of EIS detection by analyzing their electric field distributions using FEA via COMSOL multiphysics
- Innovated a dynamic incubation method of cell-based immunoassay on integrated DMF device, achieving highly sensitive quantification of human peripheral blood mononuclear cell down to 1,000 cells per mL
- Developed an electrochemical biosensor that functionalizes a reduced graphene oxide-based conductive 3D matrix structure on the sensor surface and integrates it onto a DMF device to achieve exceptional sensitivity for the detection of soluble PD-L1 protein as low as 1 pg/mL

An automated DMF device integrated with electrochemical biosensor to capture and quantify the PD-L1 level of tumor derived extracellular vesicles (EVs)

- Developed a DMF system incorporating magnetic immunoassay to directly isolate EVs from biofluids in a rapid and programmable manner with reduced sample and reagent consumption
- Optimized the durability and stability of DMF devices, by adjusting the tetronic surfactant for exceptional antifouling performance, optimizing the thickness of the Parylene C dielectric and hydrophobic layers, and fine-tuning the droplet operation voltage and frequency
- Established an electrochemical biosensor integrated on DMF devices to quantify the PD-L1 expression levels on extracted EVs in series dilution rates (10-10,000) with good linearity ($R^2 = 0.9176$)

Technical Skills: DMF, electrochemical sensor, physical vapor deposition, E-beam, sputtering, COMSOL, surface chemistry (NHS-PEG-COOH, SAM), FTIR spectrum, SEM, ELISA, western blot, AutoCAD, profilometer, flow cytometry, Shell (Bash/Zsh), LaTeX(Overleaf)

University of Cincinnati *Cincinnati, OH, USA*

Research Assistant *Oct 2015 - Dec 2020*

Sequence-specific detection of nucleic acids utilizing nanopore-based sensor

- Prototyped and implemented an innovative electroosmosis-driven nanopore-based sensor with borosilicate beads as substrate to detect microRNAs at fM range with 97.6% detection accuracy
- Participated a high-fidelity numerical model development of solid-state nanopore in COMSOL multiphysics to study the fluid flow performance and provided a validation on electroosmosis-based detection principle with nanopore
- Created mathematic models for the analysis of electrokinetics (electrophoresis, electroosmosis and dielectrophoresis) of aqueous solutions and electrokinetic particle separation phenomena
- Optimized the nucleic acid hybridization conditions including salt condition and temperature for a higher stringency between peptide nucleic acid (PNA) and microRNA/double-stranded DNA
- Designed operational amplifier circuits to amplify sub-ampere signals; logged current data using a data acquisition model (USB 6361) written in LabVIEW program; and processed the signal filtration and fitting using MATLAB

Characterization of extracellular vesicles (EVs) by an electrochemical impedance spectroscopy (EIS)-based system

- Conceptualized and developed an EIS-based measurement system to characterize EVs derived from different cellular origins based on the dielectric properties by sweeping the immobilized EVs across a frequency range from kHz to MHz
- Established an equivalent circuit model based on the Foster and Schwan circuit model to simulate the dielectric properties of vesicles in suspension as a function of frequency based on Maxwell's mixing theory
- Implemented a Python code (involving Pandas, numpy, matplotlib, openpyxl, wxPython, and cx-Freeze) to analyze the high-throughput impedance data
- Implemented the impedance-based sensor with fundamental microfabrication technologies including photolithography, wet etching, reactive-ion etching, and E-beam evaporation etc. in cleanroom
- Demonstrated the compatibility of the system with downstream analysis by characterizing the immobilized EVs with methods including Nanoparticle Tracking Analysis (NTA), TEM, western blot, ELISA and bioanalyzer

Teaching Assistant *Aug 2017 - Apr 2020*

Bio-microfluidic Systems, EECE6078

- Designed and lectured 6 COMSOL tutorials: passive/electroosmotic micromixers; micropump; dielectrophoretic separation; nanopore sensor

Biomedical Microsystems, EECE6007

- Assisted and graded >100 students with the coursework of the class; Held office hours

Technical Skills: COMSOL Multiphysics, photolithography, MATLAB, LabVIEW, cell biology, Python (NumPy, Matplotlib, Pandas), surface chemistry (EDC-NHS), bioconjugation, western blot, ELISA, NTA, DLS

Selected Publications and Talks

Journal Articles

Multiplex Detection of Infectious Diseases on Microfluidic Platforms
F. Chen, Q. Hu, H. Li, Y. Xie, L. Xiu, ***Y. Zhang****, X. Guo, and K. Yin, Biosensors* 13.3 (2023) p.410. 2023

Visual and Rapid Detection of Escherichia coli O157:H7 in Stool Samples by FTA Card-based Loop-mediated Isothermal Amplification
F. Chen, J. Wang, W. Li, ***Y. Zhang****, L. Xiu, Q. Hu, Z. Ruan, P. Chen, and K. Yin, Zoonoses* 3.1 (2023). 2023

A Digital Microfluidic Device Integrated with Electrochemical Impedance Spectroscopy for Cell-Based Immunoassay
Y. Zhang*, Y. Liu, Biosensors* 12.5 (2022) p.330. 2022

A Label-Free Electrical Impedance Spectroscopy for Detection of Clusters of Extracellular Vesicles Based on Their Unique Dielectric Properties
Y. Zhang*, K. Murakami, V.J. Borra, M.O. Ozen, U. Demirci, T. Nakamura, L. Esfandiari, Biosensors* 12.2 (2022) p.104. 2022

Advances in integrated digital microfluidic platforms for point-of-care diagnosis: a review
Y. Zhang*, Y. Liu, Sensors Diagnostics* (2022). 2022

A rapid bioanalytical tool for detection of sequence-specific circular DNA and mitochondrial DNA point mutations
Y. Zhang*, A. Kaynak, T. Huang, and L. Esfandiari, Analytical and bioanalytical chemistry* 411 (2019) pp. 1935–1941. 2019

Advancements in microfluidic technologies for isolation and early detection of circulating cancer-related biomarkers
A. Rana, ***Y. Zhang*** *and L. Esfandiari, Analyst* 143.13 (2018) pp.2971–2991. 2018

Sequence-Specific Detection of MicroRNAs Related to Clear Cell Renal Cell Carcinoma at fM Concentration by an Electroosmotically Driven Nanopore-Based Device
Y. Zhang*, A. Rana, Y. Stratton, M.F. Czyzyk-Krzeska, and L. Esfandiari, Analytical chemistry* 89.17 (2017) pp.9201–9208. 2017

Quantitative estimation of electro-osmosis force on charged particles inside a borosilicate resistive-pulse sensor
M. Ghobadi, ***Y. Zhang****, A. Rana, A., E.T. Esfahani, and L. Esfandiari, IEEE-EMBC* (2016) pp.4228–4231. 2016

Simultaneous detection of multiple charged particles using a borosilicate nanopore-based sensor
Y. Zhang *and L. Esfandiari, IEEE-NANO* (2016) pp.293–296. 2016

Materials insights into low-temperature performances of lithium-ion batteries
G. Zhu, K. Wen, W. Lv, X. Zhou, Y. Liang, F. Yang, Z. Chen, M. Zou, J. Li, ***Y. Zhang****, and W. He, Journal of Power Sources* 300 (2015) pp.29–44. 2015

The evaluation of van der Waals interaction in the oriented-attachment growth of nanotubes

W. Jin, W. He, K. Wen, X. Lin, ***Y. Zhang****, H. Cao, Y. Song, W. Lv, and J.H. Dickerson, MRS Online Proceedings Library (OPL)* (2014) pp.1705. 2014

Quantitative evaluation of Coulombic interactions in the oriented-attachment growth of nanotubes

Y. Zhang*, W. He, K. Wen, X. Wang, H. Lu, X. Lin, and J.H. Dickerson, Analyst* 139.2 (2013) pp.371–374. 2013

Conference Presentations

A digital microfluidic device integrated with electrochemical sensor and three-dimensional matrix for detecting PD-L1, Oral

Biomedical Engineering Socity (BMES), Oct. 11th-14th 2023, Seattle, WA, USA

A digital microfluidic-based electrochemical impedance spectroscopy for cell-based immunoassay in a dynamic mode, Poster

28th Annual Balfour Surgery Research Symposium, Nov 11th 2022, Rochester, MN, USA

A digital microfluidics-based electrochemical impedance spectroscopy for cell-based immunoassay detection in a dynamic mode, Oral

Miniaturized Systems for Chemistry and Life Sciences (μTAS), Oct.23th- 27th 2022, Hangzhou, China

A microfluidic platform for sensitive bacterial detection in blood through whole genome sequencing within 4 hours, Poster

27th Annual Balfour Surgery Research Symposium, Nov 12th 2021, Rochester, MN, USA

Amplification-Free Detection of Micrornas Related to Clear Cell Renal Cell Carcinoma Utilizing a Novel Nanopore-Based Sensor, Poster

Biophysical Society, Feb 17th- 22th 2018, San Francisco, CA, USA

An automated digital microfluidic platform integrated with electrochemical biosensor to detect circulating PD-L1 in extracellular vesicle and soluble forms, Oral

SELECTBIO-Lab-on-a-Chip Microfluidics World Congress, Nov. 28th-30th 2023, Laguna Hills, CA, USA

Biophysical Characterization of Exosomes Based on their Unique Dielectric Properties, Poster

Biophysical Society, Feb 15th- 19th 2020, San Diego, CA, USA

Characterization of exosomes based on their unique dielectric properties by a novel electrical impedance measurement system, Oral

International Society for Extracellular Vesicles, Apr. 24th – 28th 2019, Kyoto, Japan

Characterization of Exosomes Based on Their Unique Dielectric Properties by A Novel Electrical Impedance Measurement System, Poster

Biomedical Engineering Society, Oct. 16th – 19th 2019, Philadelphia, PA, USA

Nanopore based sensor for sequence specific microRNA detection, Poster

Miniaturized Systems for Chemistry and Life Sciences (μTAS), Oct.17th- 23rd 2017, Savannah, GA, USA

Quantitative Estimation of Electro-osmosis Force on Charged Particles inside a Borosilicate Resistive-Pulse Sensor, Poster

IEEE-Engineering in Medicine and Biology Society, Aug 15th-19th 2016, Orlando, FL, USA

Sequence specific microRNA detection by induced electroosmosis flow inside a borosilicate capillary, Poster

Center for Advanced Design Manufacturing of Integrated Microfluidics (CADMIM), Sep. 7th 2016, Cincinnati, OH, USA

Simultaneous detection of multiple charged particles using a borosilicate nanopore-based sensor, Oral

EMBS Micro and Nanotechnology in Medicine Conference, Dec.12th-16th 2016, (Win the second place), Waikoloa, HI, USA

References available upon request.