Bruce K. Gale, Ph.D.

Expertise

- Nano- /Micro- fluidic devices
- Miniature medical devices
- Surface plasmon resonance
- Biosensors
- Microscale pumps, valves, channels
- Microscale PCR systems
- Fluid dispensing
- Nanofabrication and MEMS
- Microfluidic manufacturing
- Rapid prototyping of microfluidics
- Glass and silicon micromachining
- Digital PCR
- Microfluidic interfacing and packaging
- Field flow fractionation
- Nano-/micro- particle separations

Professional Summary

Bruce K. Gale has been working in microfluidics, nanotechnology, and micro-total-analysis systems (μ-TAS) for more than twenty five years. His interests include lab-on-a chip devices that require a variety of microfluidic components for the completion of complex and challenging medical and biological assays. These components fall into 3 broad categories: sample preparation, sample separation or analysis, and detection. His work has recently involved micromachined nanoparticle separation systems and detectors, microarray manufacturing methods, high-speed PCR, miniature medical and drug delivery devices, and sensors related to these applications. His medical device patents cover: intraocular drug delivery, a Schlemm's canal stent, nerve regeneration devices, and vascular coupling devices.

Employment History

From:	2001	**University of Utah**
To:	Present	UT
	Position:	*Professor, Mechanical Engineering and Adjunct Professor, Bioengineering, Electrical and Computer Engineering, and Materials Science and Engineering*
		Classes taught: Fundamentals of Micromachining, Dynamics, Senior Design, Microfluidics, Advanced Microfluidics
From:	1999	**Institute for Micromanufacturing, Louisiana Tech University**
To:	2001	LA
	Position:	*Assistant Professor, BioMedical Engineering*
		Classes Taught: Physiology for Engineers, Biosensors and Their Applications, Biomaterials, BioMEMS, Microsystems Principles
From:	1995	**University of Utah**
To:	1999	

Position: *1996-1999: Graduate Research Assistant, Micro Instrumentation Research Laboratory*
Conducted research into a Micromachined Electrical Field Flow Fractionation system, electrical particle detection systems, biocompatibility studies, and microfluidic research on low aspect ratio channels.

Industrial and Consulting History

From:	2004	**Carterra (formerly Wasatch Microfluidics)**
To:	Present	Salt Lake City, UT
	Duties:	Serving as Principal Scientist and responsible for product development and research collaborations. Responsible for IP strategy.
From:	2007	**Early Warning / Guanine (Canadian Company)**
To:	2015	Montreal, Canada
	Duties:	Microfluidic design, nanofabrication, localized DNA attachment, thermal management
From:	2010	**Espira**
To:	Present	Salt Lake City, UT
	Duties:	Serving as Chief Engineer for product development related to digital PCR, pathogen detection, and exosome separations.
From:	2015	**Advanced Conceptions (Formerly Nanonc)**
To:	Present	Salt Lake City, UT
	Duties:	Serving as Chief Science Officer and responsible for product development and product development in the area of sperm analysis and separations and zebrafish genotyping.
From:	2016	**Microsurgical Innovations**
To:	Present	Salt Lake City, UT
	Duties:	Vice President of Engineering for startup company focused on products for vascular anastomoses.
From:	2018	**wFluidx**
To:	Present	Salt Lake City, UT
	Duties:	Vice President of Engineering for startup company focused on products for zebrafish embryo genotyping.
From:	2020	**Utah Nanoplate**
To:	2021	Salt Lake City, UT
	Duties:	Vice President of Engineering for startup company focused on products for COVID 19 diagnostics.

Litigation Support Experience

Date:	Oct 2004 – Feb 2006	**Roche Diagnostics Corporation** (Barnes and Thornburg LLP)
	Case	*Roche Diagnostics Corporation, et al. v. Apex Biotechnology Corp., Hypoguard USA, Inc., Medline Industries, Inc. and Home Diagnostics, Inc.*, Civil Action No. 1:04-CV-00358-LJM-VSS, United States District Court for the Southern District of Indiana.
	Project:	Establish terminology for case; provided deposition (1) and written reports.
	Status:	Some defendants have settled, otherwise unknown.
Date:	Feb – June 2010	**Buchanan Ingersoll & Rooney PC**
	Case:	Technical Expert on Patents 6781231; 7242089; and 7439616.
	Project:	Demonstration of public disclosure of specific knowledge
	Status:	Unknown
Date:	Sep 2010 – May 2011	**Alcon Pharmaceuticals** (Rader, Fishman, & Grauer, PLLC)
	Case:	*Elan Pharma International Limited v. Alcon Laboratories and Alcon Manufacturing, Ltd.,* Case No. 4:09-CV-32, US District Court, Eastern District of Texas
	Project:	Measure drug properties and write reports on findings
	Status:	Settled (confidential result)
Date:	Oct 2010 – June 2011	**Roche Diagnostics Corporation** (Wilmer Hale, PLLC)
	Case:	*Roche Diagnostics GmbH and Roche Diagnostics Corporation vs. Polymer Technology Systems Inc., DIS-SV-B-9138/09*
	Project:	Claim interpretation. Testified at the arbitration in Germany.
	Status:	Unknown
Date:	Oct 2014 – Sept 2017	**BioRad Corporation** (Quinn Emanuel Urquhart & Sullivan, LLP)
	Case:	*GE Healthcare Bio-Sciences AB et al. v. Bio-Rad Laboratories, Inc.* Civil Action No. 14-7080 (S.D.N.Y.) (LTS)
	Project:	Expert witness. Report writing, court testimony (1), and multiple depositions (2). Also was converted to IPR, which involved an additional deposition (1).
	Status:	Preliminary injunction refused, most claims in IPR invalidated. Court case deferred.
Date:	Nov 2017 – May 2018	**BioRad Corporation** (Quinn Emanuel Urquhart & Sullivan, LLP)
	Case:	ITC Case: Certain Microfluidic Devices, Inv. No. 337-TA-1068 (*Bio-Rad*

Laboratories vs. 10X)

Project: Expert witness. Report writing, court testimony (1), and deposition (1). Also was converted to IPR where deposition was held.

Status: Trial complete, injunction granted.

Date: July 2018 – Oct 2019 **Confluent Surgical** (Banner & Witcoff Ltd.)

Case: Confluent Surgical, Inc., Integra LifeSciences Corporation and Integra LifeSciences Sales LLC v Hyperbranch Medical Technology, Inc

Project: Expert witness. IPR and trial, Report writing and deposition (1).

Status: Confidential settlement

Date: Oct 2018 – May 2020 **Qiagen (w/NeuMoDx)** (Carlson Caspers.)

Case: Qiagen Inc vs. Handylabs Inc (Subsidiary of Becton Dickinson)

Project: Expert witness. IPR, Report writing and two depositions (2).

Status: IPR resulted in no change to patent.

Date: Feb 2020 - present **BioRad Corporation** (Quinn Emanuel Urquhart & Sullivan, LLP)

Case: *GE Healthcare Bio-Sciences AB et al. v. Bio-Rad Laboratories, Inc.* Civil Action No. 1:18-cv-01899-CFC (D. Del.)

Project: Expert witness. Report writing. One deposition (1). Trial pending.

Status: Ongoing

Date: June 2020 - present **BioRad Corporation** (Weil, Gotshal & Manges LLP)

Case: *Bio-Rad Laboratories, Inc. et al v. 10x Genomics, Inc.*, 1:19-cv-12533-WGY (D. Mass.)
Bio-Rad Laboratories, Inc. et al v. Stilla Technologies, Inc. et al, 1:19-cv-11587-WGY (D. Mass.)
Bio-Rad Laboratories, Inc. v. 10x Genomics, Inc., 3:20-cv-03207-RS (N.D. Cal.)

Project: Expert witness. Report writing. Both invalidity/infrigment and antitrust reports. Included license evaluation. Three depositions (3)

Status: Both Del. cases settled favorable to client. N.D. Cal pending trial.

Date: Sept 2020 – Nov 2020 **Aline (Stubbs Alderton & Markiles**)

Case: *American Arbitration Association, Case No. 01-19-0002-0666.*

Project: Expert witness. report writing.

Status: Confidential settlement.

Date: Feb 2020 - present **Qiagen (w/NeuMoDx**) (Carlson Caspers.)

Case: Becton, Dickinson and Company et al v. NeuMoDx Molecular, Inc., Case 1:19-cv-01126-LPS (D. Del.),

Project: Expert witness. report writing. License evaluation.
Status: Confidential settlement

Date: Sep 2020 - present **AbCellera** (Quinn Emmanuel)
Case: AbCellera Biologics Inc. v. Berkeley Lights, Inc. Civil Action No. 20-cv-00931 (D.Del.)
Project: Expert witness. report writing, now also IPR. Deposition.
Status: Pending.

Number of Depositions: 13 **Trial Testimony: 3**

Patents (26)

Patent Number	Date Issued	Title
6,136,171	1999	Micromachined Electrical Field-Flow Fractionation System
8,210,119	2012	Spotting device and method for high concentration spot deposition on microarrays and other microscale devices
8,211,382	2012	Microassay with internal referencing
8,263,392	2012	Methods and compositions related to continuous flow thermal gradient PCR
8,269,497	2012	Enhanced fill-factor NMR coils and associated methods
8,277,759	2012	Microfluidic Flow Cell
8,383,059	2013	Microfluidic interface for highly parallel addressing of sensing arrays
8,395,468	2013	High Field Strength Magnetic Field Generation System and Associated Methods
8,383,059	2013	Microfluidic interface for highly parallel addressing of sensing arrays
8,535,536	2013	Cross-flow split-thin-flow cell
8,663,194	2014	Intraocular Drug Delivery Device and Associated Methods
8,975,027	2015	Methods and compositions related to continuous flow thermal gradient PCR
8,999,726	2015	Microfluidic interface for highly parallel addressing of sensing arrays
9,095,404	2015	Intraocular Drug Delivery Device and Associated Methods
9,642,623	2017	Methods, devices and apparatus for performing a vascular anastomosis
9,682,372	2017	Tip overlay for continuous flow spotting apparatus
9,682,396	2017	Dual flow cell fluid delivery systems
9,877,973	2018	Drug Delivery Device and Associated Methods
9,931,121	2018	Methods and devices for connecting nerves
10,064,819	2018	Intraocular Drug Delivery Device and Associated Methods
10,300,450	2019	Method and device for depositing a substance on a submerged surface
10,434,515	2020	Thermal gradient plug flow microfluidic devices for extreme

		PCR
10,300,479	2020	Tip overlay for continuous flow spotting apparatus
10,588,855	2020	Intraocular Drug Delivery Device and Associated Methods
10,667,816	2020	Vascular Coupling Device
10,772,633	2020	Methods and devices for connecting nerves
10,842,494	2020	Methods and devices for connecting nerves

Education

Year	College/University	Degree
2000	University of Utah	Ph.D., Bioengineering
1995	Brigham Young University	BS, Mechanical Engineering (Summa Cum Laude)

Awards

May 2022	Named Merit Medical Systems Inc. Endowed Professor of Engineering
May 2022	Governor's Medal (Utah) for Science and Technology in Academia/Research
November 2021	Fellow of the National Academy of Inventors
August 2021	Fulbright Specialist in Microfluidics
April 2020	University of Utah Distinguished Research Award
April 2019	Honoree in the Entrepreneur Category at the 2019 Celebrate U event
April 2018	Honoree in the Entrepreneur Category at the 2018 Celebrate U event
August 2017	Researcher of the Year for 2016, Mechanical Engineering Department
September 2016	TVC Star Award
August 2014	Researcher of the Year for 2013, Mechanical Engineering Department
May 2014	Distinguished Mentor Award, University of Utah
August 2013	Researcher of the Year for 2012, Mechanical Engineering Department
Fall 2004, 2010, 2011	Top 15% Instructor Commendation, College of Engineering
April, 2004	Nominated for Student Choice Teaching Award
September 2001	Louisiana Tech College of Engineering Outstanding Researcher Award
1996-1999	NSF Graduate Research Fellowship
March 1996	Awarded Whitaker Foundation Graduate Research Fellowship
1995-1996	Whitaker Foundation Biobased Engineering Internship

Publications

Journal Articles

1. Dhruv Patel, Ugochukwu Nze; Christopher Lambert, Harikrishnan Jayamohan, Haidong Feng, Bruce Gale, Himanshu Sant, "Design of a Hydrodynamic Cavitation System for the Extraction and Detection of Escherichia coli (O157:H7) from Ground Beef," *Sensors and Actuators B: Chemical*, accepted.

2. Nusrat Tazin, Dhruv Patel, Christopher Jordon Lambert, Mohammad H.M. Shad , Jeff Campbell, Bruce K. Gale, "Automated passive serial dilution microfluidic chip for calcium quantification based on the Arsenazo III method," *Sensors & Diagnostics*, 2022, DOI: 10.1039/D2SD00022A.

3. Susan Wojtalewicz, Jonathon Vizmeg, Sierra Erickson, Caleb Lade, Jill Shea, Himanshu Sant, Jules Magda, Brett Davis, Bruce Gale, Jayant Agarwal, "Evaluating the influence of particle morphology and density on the viscosity and injectability of a novel long-acting local anesthetic suspension," *Journal of Biomaterials Applications*, accepted.
4. Farhad Shiri, Haidong Feng, Kevin E. Petersen, Himanshu Sant, Gina T. Bardi, Luke A. Schroeder, Michael L. Merchant, Bruce K. Gale & Joshua L. Hood, "Separation of U87 glioblastoma cell-derived small and medium extracellular vesicles using elasto-inertial flow focusing (A spiral channel)," *Scientific Reports*, Vol. 12:6146, 2022. doi.org/10.1038/s41598-022-10129-8
5. Haidong Feng, Alexander R Jafek, Bonan Wang, Hayden Brady, Jules J Magda, Bruce K Gale, "Viscoelastic Particle Focusing and Separation in a Spiral Channel," *Micromachines*, in press.
6. Kevin E Petersen, Farhad Shiri, Tonguc Onur Tasci, Himanshu Sant, Joshua Hood, Bruce Gale, "Experiment, Theory, and Simulation of a Flow-Electrical-Split Flow Thin Particle Separation Device", *Journal of Chromatography A*, Vol. 1659, pp. 462634, 2021. DOI: 10.1016/j.chroma.2021.462634
7. John Nelson, Dev Patel, Himanshu Sant, Jill Shea, Bruce Gale, Jay Agarwal, "Compression of the Vascular Wall to Create a Friction Fit in a Vascular Anastomotic Coupler," *Journal of the Mechanical Behavior of Biomedical Materials*, accepted.
8. Haidong Feng, Alex Jafek, Raheel Samuel, James Hotaling, Timothy G. Jenkins, Kenneth I. Aston, and Bruce K. Gale, "High efficiency rare sperm separation from biopsy samples in an inertial focusing device," *Analyst*, Vol. 146, pp. 3368 – 3377, 2021. DOI: 10.1039/d1an00480h
9. Farhad Shiri, Bruce Gale, Himanshu Sant, Brody King, Gina Bardi, Joshua Hood, Kevin Petersen, "Development and Testing of a Continuous Flow-Electrical-Split-Flow Lateral Transport Thin Separation System (Fl-El-SPLITT)," Anal. Chem., published on the web, 2021. DOI: 10.1021/acs.analchem.0c04345.
10. Pratima Labroo, Scott Ho, Himanshu Sant, Jill E Shea, Jayant Agarwal, Bruce Gale, "Modelling diffusion based drug release inside a nerve conduit-In vitro and In vivo validation study," *Drug Delivery and Translational Research*, Vol. 11, pp. 154–168, 2021. doi: 10.1007/s13346-020-00755-y
11. Sabin Nepal, Haidong Feng, Bruce K. Gale, "Optimization of a microfluidic spiral channel used to separate sperm from blood cells," *Biomicrofluidics*, accepted.
12. Haidong Feng, Matthew Hockin, Mario Capecchi, Bruce Gale, and Himanshu Sant, "Size and shape based chromosome separation in an inertial focusing device," *Biomicrofluidics*, accepted. (Featured article and cover)
13. Harikrishnan Jayamohan, Christopher J. Lambert, Himanshu J. Sant, Alexander Jafek, Dhruv Patel, Haidong Feng, Michael Beeman, Tawsif Mahmood, Ugochukwu Nze, & Bruce K. Gale, "SARS-CoV-2 pandemic: a review of molecular diagnostic tools including sample collection and commercial response with associated advantages and limitations," Anal. Bioanal. Chem., published on the web. https://doi.org/10.1007/s00216-020-02958-1
14. Brett Davis, Sierra Erickson, Susan Wojtalewicz, Andrew Simpson, Cameron Metcalf, Himanshu Sant, Jill Shea, Bruce Gale, Jay Agarwal, "Entrapping bupivacaine-loaded emulsions in a crosslinked-hydrogel increases anesthetic effect and duration in a rat sciatic nerve block model," *International Journal of Pharmaceutics*, accepted. https://doi.org/10.1016/j.ijpharm.2020.119703

15. Alex Jafek, Haidong Feng, Hayden Brady, Kevin Petersen, Marzieh Charharlang, Kenneth Aston, Bruce Gale, Timothy Jenkins, Raheel Samuel, "An Automated Instrument for Intrauterine Insemination Sperm Preparation," *Scientific Reports*, Vol. 10, 21385, pp. 1-9, 2020. doi.org/10.1038/s41598-020-78390-3.
16. Alex Jafek, Haidong Feng, Dallin Broberg, Bruce Gale, Raheel Samuel, Kenneth Aston, Timothy Jenkins, "Optimization of Dean-flow microfluidic chip for sperm preparation for intrauterine insemination," *Microfluidics and Nanofluidics*, accepted.
17. Farhad Shiri, Bruce K. Gale, Himanshu Sant, Gina Bardi, Joshua Hood, Kevin Petersen, "Characterization of Human Glioblastoma versus Normal Plasma-derived Extracellular Vesicles Pre-isolated by Differential Centrifugation using Cyclical Electrical Field-flow Fractionation, *Anal. Chem*., Vol. 92, pp. 9866-9876, 2021.
18. Cathy L. Mangum, Darshan P. Patel, Alexander R. Jafek, Raheel Samuel, Tim G. Jenkins, Kenneth I. Aston, Bruce K. Gale, and James M. Hotaling, "Towards a better testicular sperm extraction: novel sperm sorting technologies for non-motile sperm extracted by microdissection TESE," *Transl Androl Urol*. Vol. 9(Suppl 2), pp. S206–S214, 2020. doi: 10.21037/tau.2019.08.36
19. Haidong Feng, Matthew Hockin, Shuhua Zhang, Mario Cappecchi, Bruce K. Gale, Himanshu Sant, "Enhanced Chromosome Extraction from Cells Using A Pinched Flow Microfluidic Device," *Biomed. Microdev*., Vol. 22 25, 2020.
20. Farhad Shiri, Kevin E. Petersen, Valentin Romanov, Qin Zou, and Bruce K. Gale, "Characterization and Differential Retention of Q beta bacteriophage Virus-like Particles using Cyclical Electrical Field-Flow Fractionation and Asymmetrical Flow Field-Flow Fractionation," *Anal. Bioanal. Chem*., Vol. 412(7), pp. 1563-1572, 2020. DOI: 10.1007/s00216-019-02383-z
21. Raheel Samuel, Haidong Feng, Alex Jafek, Timothy G. Jenkins, Jiyoung Son, Bruce K. Gale, Douglas Carrell, Jim Hotaling, "Microfluidic system for rapid isolation of sperm from microdissection TESE specimens," *Urology*, Vol. 140, pp. 70-76, 2020. https://doi.org/10.1016/j.urology.2019.12.053
22. Ligeng Shao, Kevin Petersen, Farhad Shiri, Haidong Feng, Bruce Gale, "Characteristics of electrical field flow fractionation with chronoamperometry and electrochemical impedance," *Micro & Nano Letters*, Vol. 15, pp. 13-17, 2020. DOI: 10.1049/mnl.2018.5663
23. Haidong Feng, Jules J. Magda, and Bruce K. Gale, "Viscoelastic second normal stress difference dominated multiple-stream particle focusing in microfluidic channels," *Applied Physics Letters*, Vol. 115, pp. 263702, 2019. DOI: 10.1063/1.5129281.
24. Brett Davis, David Hilgart, Sierra Erickson, Pratima Labroo, Joshua Burton, Himanshu Sant, Jill Shea, Bruce K. Gale, Jay Agarwal, "FK506 delivery at the direct nerve repair site improves nerve regeneration," *Muscle and Nerve*, Vol. 60, pp. 613-620, 2019. DOI: 10.1002/mus.26656
25. Matt Nelson, Nirupama Ramkumar, Bruce K. Gale, "Flexible, transparent, sub-100 μm microfluidic channels with FDM 3D-printed thermoplastic polyurethane," *J. Micromech. Microeng*. Vol. 29, pp. 095010 (8 pp), 2019. https://doi.org/10.1088/1361-6439/ab2f26
26. Valentin Romanov, John McCullough, Bruce K. Gale, Adam Frost, "A tunable microfluidic device enables cargo encapsulation by cell-or organelle-sized lipid vesicles comprising

asymmetric lipid bilayers", *Advanced Biosystems*, Vol. 3, pp. 1900010 (9 pages), 2019. DOI: 10.1002/adbi.201900010

27. Ugochukwu C. Nze, Michael G. Beeman, Christopher J. Lambert, Ghadhanfer Salih, Bruce K. Gale, Himanshu J. Sant, "Hydrodynamic cavitation for the rapid separation and electrochemical detection of Cryptosporidium parvum and Escherichia coli O157:H7 in ground beef," *Biosensors and Bioelectronics*, Vol. 135, pp. 137-144, 2019. https://doi.org/10.1016/j.bios.2019.04.002
28. Jiyoung Son, Alexander R. Jafek, Douglas T. Carrell, James M. Hotaling, and Bruce K. Gale, "Sperm like particle (SLP) behavior under curved microfluidic channel and its application to inertial microfluidics principles," *Microfluidics and Nanofluidics*, Vol. 23:4, 2019. https://doi.org/10.1007/s10404-018-2170-1.
29. Jie Zhang, Sudeepa Bhattacharyya, Robert C. Hickner, Alan R. Light, Christopher J. Lambert, Bruce K. Gale, Oliver Fiehn, Sean H. Adams, "Skeletal muscle interstitial fluid metabolomics at rest and associated with an exercise bout: application in rats and humans," *AJP-Endocrinology and Metabolism*, Vol. 316, E43-E53, 2019.
30. Pratima Labroo, David Hilgart, Brett Davis, Himanshu J. Sant, Bruce K. Gale, Jill Shea, Jayant Agarwal, "Drug-delivering nerve conduit improves regeneration in a critical sized gap," *Biotechnology and Bioengineering*, Vol. 116, No. 1, pp. 143-154, 2019. DOI: 10.1002/bit.26837
31. Kevin Petersen, Farhad Shiri, Travis White; Gina Bardi, Himanshu Sant, Bruce Gale, Joshua Hood, "Exosome Isolation: Cyclical Electrical Field Flow Fractionation in Low Ionic Strength Fluids," *Anal. Chem*, Vol. 90, pp. 12783-12790, 2018.
32. Alexander R. Jafek, Chris Lambert, Brady Goenner, Hossein Moghimifam, Ugochukwu Nze, Suraj Kumar, Bruce K. Gale, "A Review of Current Methods in Microfluidic Device Fabrication and Future Commercialization Prospects," *Inventions*, Vol. 3, pp. 60 (25 pages), 2018; doi:10.3390/inventions3030060.
33. Valentin Romanov, Raheel Samuel, Marzieh Chaharlang, Alexander R. Jafek, Adam Frost, and Bruce K. Gale, "FDM 3D Printing of High-Pressure, Heat-Resistant Transparent Microfluidic Devices," *Anal. Chem.*, Vol. 90 (17), pp. 10450-10456, 2018; DOI: 10.1021/acs.analchem.8b02356
34. Brett Davis, Susan Wojtalewicz , Pratima Labroo, Jill Shea, Himanshu Sant, Bruce K. Gale, and Jayant Agarwal, "Controlled release of FK506 from micropatterned PLGA films: Potential for application in peripheral nerve repair," *Neural Regeneration Research*. Vol. 13, 1247-1252, 2018
35. Raheel Samuel, Haidong Feng, Alex Jafek, Dillon Despain, Timothy Jenkins, Bruce Gale, "Microfluidic—based sperm sorting & analysis for treatment of male infertility," *Translational Andrology and Urology*, Vol. 7(Suppl 3): S336–S347, 2018. doi: 10.21037/tau.2018.05.08.
36. Raheel Samuel, Nicholas Miller, Odgerel Badamjav, Timothy Jenkins, James Hotaling, Douglas Carrell, Bruce Gale, "Design and operation of a microfluidic chip for trapping, and off-chip collection of a few human sperm," *J. Micromech. Microeng.*, Vol. 28, pp. 097002, 2018. Doi:10.1088/1361-6439/aac40f.
37. Michael G. Beeman, Ugochukwu C. Nze, Himanshu J. Sant, Hammad Malik, Swomitra Mohanty, Bruce K Gale, Krista Carlson, "Electrochemical Detection of E. coli O157:H7 in Water after Electrocatalytic and Ultraviolet Treatments Using a Polyguanine-Labeled Secondary Bead Sensor," *Sensors*, Vol. 18(5) pp. 1497, 2018.

38. Alexander Jafek, Sean Harbertson, Hayden Brady, Raheel Samuel, Bruce K. Gale, "Instrumentation for xPCR incorporating qPCR and HRMA," *Anal. Chem.*, Vol. 90 (12), pp 7190–7196, 2018. DOI: 10.1021/acs.analchem.7b05176

39. Scott Ho, Pratima Labroo, Keng-min Lin, Himanshu Sant, Jill Shea, Bruce K. Gale, Jay Agarwal, "Designing a bioresorbable drug delivery conduit to promote nerve regeneration-a preliminary study," *Journal of Medical and Biological Engineering*, 2018. DOI: 10.1007/s40846-018-0393-y

40. Christopher J. Lambert, Briana C. Freshner, Arlen Chung, Tamara J. Stevenson, D. Miranda Bowles, Raheel Samuel, Bruce K. Gale, Joshua L. Bonkowsky, "An automated system for rapid cellular extraction from live zebrafish embryos and larvae: development and application to genotyping," *PLOS ONE*, published March 15, 2018. DOI: 10.1371/journal.pone.0193180

41. Ching-Wen Li, Jill Shea, Himanshu Sant, Jay Agarwal, Bruce K. Gale, "Optimization of Micropatterned PLGA Films for Enhancing Dorsal Root Ganglion Cell Orientation and Extension," *Neural Regeneration Research*, Vol. 13(1), pp. 105-111, 2018. DOI: 10.4103/1673-5374.224377

42. Ryan Brewster, Bruce K. Gale, Himanshu J. Sant, Ken Monson, Jill Shea, Jay Agarwal, "A Biodegradable Vascular Coupling Device for End-to-End Anastomosis," *Journal of Medical and Biological Engineering*, published on the web December 7, 2017. DOI: /10.1007/s40846-017-0348-8

43. Jiyoung Son, Raheel Samuel, Bruce K. Gale, Douglas T. Carrell, James M. Hotaling, "Separation Of Sperm Cells From Samples Containing High Concentrations Of White Blood Cells Using A Spiral Channel," *Biomicrofluidics*, Vol. 11, pp. 054106, 2017. DOI: /10.1063/1.4994548.

44. Pratima Labroo, Jill Shea, Kyle Edwards, Scott Ho, Brett Davis, Himanshu Sant, Isak Goodwin, Bruce K. Gale, Jay Agarwal, "Novel drug delivering conduit for peripheral nerve regeneration," *Journal of Neural Engineering*, Vol. 14(6), pp. 066011, 2017. doi: 10.1088/1741-2552/aa867d.

45. Jesús Arellano, Taylor Howell, James Gammon, Sungpil Cho, Margit Janat-Amsbury, and Bruce Gale, "Use of a highly parallel Microfluidic Flow Cell Array to determine therapeutic drug dose response curves," *Biomedical Microdevices*, Vol. 25, No. 19, 2017. DOI: 10.1007/s10544-017-0166-3.

46. Huizhong Li, Jill Shea, Himanshu Sant, Bruce K. Gale, Christi Terry, Jay Agarwal, "Vascular Coupling System for End-to-End Anastomosis - An *In Vivo* Pilot Case Report," *Cardiovascular Engineering and Technology,* Vol. 8, No. 1, pp. 91-95, March 1, 2017.

47. Pratima Labroo, Jill E Shea, Himanshu Sant, Bruce K Gale, Jayant Agarwal, "Effect of combining FK506 and neurotrophins on axonal branching and elongation," *Muscle & Nerve*, Vol. 55(4), pp. 570–581, 2017. DOI: 10.1002/mus.25370

48. Vicki Ragsdale, Huizhong Li, Himanshu Sant, Tim A. Ameel, and Bruce K. Gale, "A Disposable Continuous-flow Polymerase Chain Reaction Device-Design, Fabrication and Evaluation" *Biomedical Microdevices*, Vol. 18, No. 4, pp. 1-9, 2016.

49. Pratima Labroo, Scott Ho, Himanshu Sant, Jill Shea, Bruce K. Gale, Jayant Agarwal, "Controlled Delivery of FK506 to Improve Nerve Regeneration," *Shock,* Vol. 46(3 Suppl 1), pp. 154-9, 2016. doi: 10.1097/SHK.0000000000000628

50. Russell C. Reid, Sean R. Jones, David P. Hickey, Shelley D. Minteer, Bruce K. Gale, "Modeling Carbon Nanotube Connectivity and Surface Activity in a Contact Lens Biofuel Cell," *Electrochim. Acta,* Vol. 203, pp. 30-40, 2016.

51. Keng-Min Lin, Jill Shea, Bruce Gale, Himanshu Sant, Patti Larrabee, Jay Agarwal, "Nerve growth factor released from a novel PLGA nerve conduit can improve axon growth," *J Micromech. Microeng.*, Vol. 26 (4), pp. 045016, 2016.

52. Raheel Samuel, Odgerel Badamjav, Kristin E Murphy, Darshan P Patel, Jiyoung Son, Bruce K Gale, Douglas T Carrell, James M Hotaling, "Microfluidics: The Future of Microdissection TESE Sperm Processing?" *Systems Biology in Reproductive Medicine,* Vol. 62(3), pp.161-170, 2016.

53. Deng Yan, Chen Jiao, Zhao Yi, Choy Kwong Wai, Xu Yan, Hu Jun, Himanshu J Sant, Bruce K Gale, and Tang Tao, "Microneedle Array Delivery of siRNA to Skin for Gene Silencing," *Scientific Reports,* Vol. 6, pp. 21422, 2016.

54. Mathuros Ornthai, Atitaya Siripinyanond, and Bruce K. Gale, "Effect of Ionic and Non-Ionic Carriers in Electrical Field-Flow Fractionation, *Anal. Chem.*, Vol. 88 (3), pp 1794–1803, 2016.

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Editorials

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Book Chapters

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2. Harikrishnan Jayamohan, Himanshu J. Sant, and Bruce K. Gale, "Applications of Microfluidics for Molecular Diagnostics," in *Microfluidic Diagnostics: Methods and Protocols, Volume 2: Application Protocols and Commercialization*, Colin D. Mansfield and Gareth Jenkins, eds., Humana Press: New York, 2012.
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Invited Conference Papers/Presentations

1. Bruce Gale, "Taking Microfluidics From Research Ideas to a Real Product," in *Proc. ASME 2019 International Mechanical Engineering Congress and Exposition (IMECE), November 10–14, 2019, Salt Lake City, Utah, USA*, IMECE2019-14008, 2019.
2. Bruce K. Gale, "The History and Applications of Electrical Field Flow Fractionation," in *Proc. Of 18th International Symposium on Field-and Flow-based Separations,* Columbia, SC, USA, , May 14-17, 2018.
3. Bruce K. Gale, "The Future Of Diagnostic Labs: Lab-On-A-Chip," 2018 Spring Seminar of the Utah Chapter of the American Society for Clinical Laboratory Science, Salt Lake City, UT, May 4, 2018.
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94. Srinivas Merugu, and Bruce K. Gale, "Combining Normal and Cyclical Electrical Field Flow Fractionation," in *Proc. of 13th International Symposium on Field-and Flow-based Separation, Salt Lake City, UT, June 27-30, 2007*, pp. L33.

95. Himanshu J. Sant, Srinivas Merugu, and Bruce K. Gale, "Numerical Simulations of Transport Processes in Electrical Field-Flow Fractionation Systems," in *Proc. of 13th International Symposium on Field-and Flow-based Separation, Salt Lake City, UT, June 27-30, 2007*, pp. P31.

96. Himanshu J.Sant and Bruce K. Gale, "Improvements in Microscale Thermal-Field Flow Fractionation Instrumentation," in *Proc. of 13th International Symposium on Field-and Flow-based Separation, Salt Lake City, UT, June 27-30, 2007*, pp. P41.

97. Sriram Natarajan, Bruce K. Gale, and David G. Myszka, "Continuous Flow Enhancement of Microarray Spots for Flexchip Analysis," in *Developments in Protein Interaction Analysis 2007*, May 6-9, 2007, Phoenix, AZ.

98. Mark A. Eddings and Bruce K. Gale, "A PDMS Diffusion Pump For On-Chip Fluid Handling In Microfluidic Devices," to be presented at *Second Annual Mountain West Biomedical Engineering Conference*, Snowbird, UT, Sept 15-17, 2006.

99. Scott O. Sundberg, Jenny Greer, Carl T. Wittwer, Robert J. Pryor, Oluwole Elenitoba-Johnson, and Bruce K. Gale, "Homogeneous DNA Melting Analysis For Mutation Scanning Using Nanoliter Volumes," to be presented at *Second Annual Mountain West Biomedical Engineering Conference*, Snowbird, UT, Sept 15-17, 2006.

100. Jungkyu Kim and Bruce K. Gale, “Geometric Optimization Of A Thin Film Ito Heater To Generate A Uniform Temperature Distribution,”to be presented at *Second Annual Mountain West Biomedical Engineering Conference*, Snowbird, UT, Sept 15-17, 2006.

101. Jungkyu Kim, Karl V. Voelkerding, Bruce K. Gale “Microfluidic DNA extraction array with patterned AIOx membrane,” in *Proc. Of The 1st Annual Mountain West Biomedical Engineering Conference Snowbird, UT*, September 16-17, 2005

102. H.J. Sant and B.K. Gale, “Field programming in microscale electrical field flow fractionation,” in *Proc. Of The 1st Annual Mountain West Biomedical Engineering Conference Snowbird, UT*, September 16-17, 2005

103. Scott O. Sundberg, Carl T. Wittwer, Bruce K. Gale, “DNA Melting Analysis on a Nano-Volume Scale,” in *Proc. Of The 1st Annual Mountain West Biomedical Engineering Conference Snowbird, UT*, September 16-17, 2005.

104. Phini Katsamba, Rebecca Rich, Michelle Cannon, Jerry Jenkins, Prabhakar Pandian, Bruce Gale, Shankar Sundaram & David Myszka, "Extracting Kinetics from the Array-Based FLEXchip SPR Biosensor," in *Proc. of Developments in Protein Interaction Analysis Conference 2005*, Philadelphia, PA, August 28-31, 2005.

105. Ameya Kantak, Srinivas Merugu, and Bruce K. Gale, "Improved Theory of CyElFFF and Characterization of m-CyElFFF," in *Proc. Of the 12th International Symposium on Field Flow Fractionation*, Brno, Czech Republic, August, 28-30, 2005.

106. Himanshu Sant and Bruce K. Gale, "An Integrated polymer waveguide based optical flowcell for microscale field flow fractionation systems," in *Proc. Of the 12th International Symposium on Field Flow Fractionation*, Brno, Czech Republic, August, 28-30, 2005.

107. Himanshu Sant and Bruce K. Gale, "Field programming in microscale electrical field flow fractionation," in *Proc. Of the 12th International Symposium on Field Flow Fractionation*, Brno, Czech Republic, August, 28-30, 2005.

108. D. A Chang-Yen, D. Myszka and B. K. Gale, “A PDMS Microfluidic Spotter for Fabrication of Protein Chips and Microarrays,” in *Proc. Of LabAutomation 2005, San Jose, CA* January 30 - February 3, 2005

109. Harvey, Ian R.; Miller, Mark S.; Blair, Steve; Ameel, Tim; Gale, Bruce K.; Ring, Terry, "Building academic, research, and commercialization programs in micro and nano science and engineering at the University of Utah," *Biennial University/Government/Industry Microelectronics Symposium - Proceedings*, 2003, p 33-35.

110. Ameya Kantak and Bruce K. Gale, "Microscale Cyclical Electrical Field Flow Fractionation," in *Proc. Of the 11th International Symposium on Field Flow Fractionation*, Cleveland, OH, October 7-10, 2003.

111. Himanshu Sant and Bruce K. Gale, "Optical Detectors for Miniaturized FFF Systems," in *Proc. Of the 11th International Symposium on Field Flow Fractionation*, Cleveland, OH, October 7-10, 2003.

112. Srinivas Merugu, Nithin Narayanan, and Bruce K. Gale, "Microscale Serial SPLITT Systems," in *Proc. Of the 11th International Symposium on Field Flow Fractionation*, Cleveland, OH, October 7-10, 2003.

113. Siddharth Chakravarthy and Bruce K. Gale, "PolyPIPosome Characterization using a Combination of Normal and Cyclical Electrical Field Flow Fractionation," in *Proc. Of the 11th International Symposium on Field Flow Fractionation*, Cleveland, OH, October 7-10, 2003.

114. Meregu Srinivas and Bruce K. Gale, "Cyclical Electrical Field Flow Fractionation," in *Proc. Of the 10th International Symposium on Field Flow Fractionation*, Amsterdam, Netherlands, July 2-5, 2002.

115. Himanshu J. Sant and Bruce K. Gale, "A Microfabricated Thermal Electric Field Flow Fractionation System," in *Proc. Of the 10th International Symposium on Field Flow Fractionation*, Amsterdam, Netherlands, July 2-5, 2002.

116. Avinash Saldanha and Bruce K. Gale, "Microfabricated Electrical SPLITT System," in *Proc. of the 10th International Symposium on Field Flow Fractionation*, Amsterdam, Netherlands, July 2-5, 2002.

117. Sreenivas Rao, Himanshu Sant, and Bruce K. Gale, "Minimization of End Effects in Field Flow Fractionation," in *Proc. Of the 10th International Symposium on Field Flow Fractionation*, Amsterdam, Netherlands, July 2-5, 2002.

118. Charles J Robinson, K Briski, B Choi, PD Coppola, T-H Cui, A Dunn, T Ehsan, Bruce K Gale, W Green, AM Hollister, A Jawahar, HF Ji, S Jones, Y Lvov, M McShane, D Mills, J Patterson, S Patton, H Price, S Roerig, M Sahin, R Schubert, W Simms, K Varahramyan, "The Newlane Consortium (Neural Engineering With Louisiana North Excellence) Building Newlanes To Record And Restore Neural Function," in *Proc. of Third Rehabilitation Research and Development Conference: Rehabilitation Research for the Twenty-First Century: The New Challenges*, Arlington, VA, February 10-12, 2002.

119. Mengyan Li, Hua Ai, David K. Mills, Yuri M. Lvov, Bruce K. Gale, "Increasing the Alignment of Smooth Muscle Cells by 100 mm Channels with Micro- and Nano-Technology," in *Proc. of IBE 2002 International Meeting: Interfacing Biology and Engineering*, Baton Rouge, LA, January 18-20, 2002

120. John Glawe, David Mills, and Bruce K. Gale, "Analysis of Cell Organization in a Smooth Muscle Culture Grown On High Aspect Ratio Microstructures," in *Proc. of IUVSTA 15th International Vacuum Congress (IVC-15), AVS 48th International Symposium (AVS-48), 11th International Conference on Solid Surfaces (ICSS-11)*, San Francisco, CA, October 28 - November 2, 2001.

121. Ameya Kantak, Himanshu Sant, Bruce K. Gale, David K. Mills, Yuri Lvov, and Steve Jones, "A Microfabricated Platelet Analyzer," in *Proc. Smalltalk 2001*, San Diego, CA, August 27-31, 2001.

122. Himanshu J. Sant and Bruce K. Gale, “Improved Scaling Models for Electrical and General Field Flow Fractionation Systems,” in *Proc. 9th International Symposium on Field-Flow Fractionation*, Boulder, CO, June 26-29, 2001.

123. Avinash Saldanha and Bruce K. Gale, “A Microfabricated Electrical SPLITT System,” in *Proc. 9th International Symposium on Field- Flow Fractionation*, Boulder, CO, June 26-29, 2001.

124. Bruce K. Gale and Mahesh Thoppil, “A Microfabricated Cyclical Electrical Field Flow Fractionation System,” in *Proc. 9th International Symposium on Field- Flow Fractionation*, Boulder, CO, June 26-29, 2001.

125. Bruce K. Gale, “Microfabricated FFF and SPLITT Systems,” in *Proc. Tex MEMS III*, Dallas, TX, June 7, 2001.

126. Himanshu J. Sant and Bruce K. Gale, "Improved Models for Geometric Scaling in Field-Flow Fractionation," in *Proc. of the Nineteenth Annual Houston Conference on Biomedical Engineering Research*, Houston, TX, February 8-9, 2001.

127. Bruce K. Gale, Karin D. Caldwell, and A. Bruno Frazier, "Blood and Protein Separations Using a Micromachined Electrical Field- Flow Fractionation System," in *Proc. of the Eighteenth Annual Houston Conference on Biomedical Engineering Research*, Houston, TX, Feb 10-11, 2000.

128. Bruce K. Gale, Karin D. Caldwell, and A. Bruno Frazier, "Scaling Effects in a Micromachined Electrical Field Flow Fractionation System," in *Proc. 8th International Symposium on Field- Flow Fractionation*, Paris, France, Sep. 6-8, 1999.

129. Bruce K. Gale, Karin D. Caldwell, and A. Bruno Frazier, "Characterization of a Micromachined Electrical Field- Flow Fractionation System," in Proc. 7th International Symposium on Field-flow Fractionation, Salt Lake City, UT, Feb. 8-11, 1998.

130. Bruno Frazier, Karin Caldwell, Tim Ameel, Bruce K. Gale, and Ian Papautsky, "Micro scale fluid analysis systems: applications and engineering issues," in Proc. 7th International Symposium on Field-flow Fractionation, Salt Lake City, UT, Feb. 8-11, 1998.

Invited Workshop Presentations

1. Bruce K. Gale, "Rapid and Inexpensive Microfluidics-Based Tools for Clinical and Environmental Applications," at the Digital PCR Shortcourse, Molecular Medicine Tri-Con 2013, San Francisco, CA, February 12, 2013.
2. Bruce K. Gale, "Active Components for Microfluidic Manipulation," CAMD / CBM2 2005 Summer Workshop, Baton Rouge, Louisiana, July 25-29, 2005.
3. Bruce K. Gale, Ian Harvey, and Tim Ameel, "MEMS Workshop" sponsored by Korean Government, January 12-16, 2004. Full week course involving lectures and labs for 8 Professors from Korea on MEMS and MEMS education.
4. Bruce K. Gale and Michael J. McShane, "BioMEMS and Biomedical Optics," Shortcourse Sponsored by Government of Taiwan (ROC), March 6-8, 2001 (Full three days of presentations: Over 100 paid attendees).
5. Bruce K. Gale, "Advanced Bio-MEMS Techniques and Research Applications" BioMEMS workshop at Chicago 2000, the World Congress on Medical Physics and Biomedical Engineering, Chicago, IL, July 22, 2000.
6. Bruce K. Gale, "Introduction to BioMEMS," Microfabrication Short Course held with the First Annual Louisiana Microsystems Conference, Ruston, LA, April 4, 2000.
7. Bruce K. Gale, Laboratory Instruction in Microfabrication, MEMS Bootcamp, University of Utah, May 1999.

Classes Taught

Fall 2012, 2013, 2014, 2016, 2017	Instructor, ME EN 2450 Numerical Methods for Sustainable Engin. Design (3 h)
Spring 2011-2012, 2015	Instructor, ME EN 4010 Senior Design II (3 h)
Fall 2009-2011, -20, Spring 2013, -15, -17, -19	Instructor, ME EN 5/6730 and ECE 5/6962 and BME 5/6701 Microfluidic Chip Design and Fabrication (3 h)
Spring 2006/-08/-18	Instructor, ME EN 7960 and Bioen 6900 Microfluidic Design and Simulation (3 h)
Fall 2002-2007, 2019	Instructor, ME EN 2400 &2410 Dynamics, University of Utah (4 h)
Spring 2002,-03,-05,-	Instructor, ME EN 5050 & 6050, ECE 5221 and 6221, BIOEN 6421

07, -13	Introduction to Micromachining, University of Utah (3 h)
Fall 2001	Instructor, MSE 501 Microsystems Principles, Louisiana Tech (3 h)
Winter 2000-2001	Instructor, BIEN 550C Biomedical Microsystems, Louisiana Tech (3 h)
Spring 2000 and 2001	Instructor, BIEN 420 Biomaterials and Biomechanics, Louisiana Tech (3 h)
Winter 1999-2000	Instructor, BIEN 515 Biosensors and Their Applications, Louisiana Tech (3 h)
Fall 1999 and 2000	Instructor, BIEN 500 Physiology for Engineers, Louisiana Tech, (4 h)
Fall 1998	Co-Instructor, BE 6900 & EE 6960: Micromachined Instrumentation Systems University of Utah. (3 h)

Professional Associations

2018-present	Member, American Society of Mechanical Engineers (ASME)
2001-2003	Member American Society for Engineering Education (ASEE)
2001-2003	Member, American Chemical Society (ACS)
2000-2002	Member, Institute for Microelectronics and Packaging Systems (IMAPS)
1997-present	Member, Institute for Electrical and Electronics Engineers (IEEE)
1997-present	Member, IEEE Engineering in Medicine and Biology Society (EMBS)