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Objective:

Researcher experienced in the design and development of acoustic microfluidic devices and custom instrumentation systems for biomedical applications pursuing research on the development of innovative, cost-effective diagnostic tools and techniques to meet challenges in global healthcare

Education:

- Ph.D., Chemical Engineering, University of New Mexico, Albuquerque, NM, USA [2009 -2013]
- B.Tech, Chemical Engineering, St. Joseph's College of Engineering (Affiliated to Anna University), Chennai, India [2005-2009]
- Higher Secondary, Vana Vani Matriculation Higher Secondary School, Chennai, India [2003-2005]
- High School, Vana Vani Matriculation Higher Secondary School, Chennai, India [2001-2003]

Employment:

- Institute Post Doctoral Fellow, Department of Mechanical Engineering, Indian Institute of Technology – Madras (IITM), Chennai, India [June 2017-Present]
- Postdoctoral Associate, Triangle Materials Research Science and Engineering Center (MRSEC), Duke University, Durham, NC, USA [2015-2016]

- Postdoctoral Researcher, Center for Biomedical Engineering, Department of Chemical and Biological Engineering, University of New Mexico, Albuquerque, New Mexico, USA [January-December 2014]

Awards:

- Received the "*Outstanding Graduate Student Award*" from the Department of Chemical and Nuclear Engineering at the University of New Mexico in May 2013

- Won "*Student Travel Award*" at CYTO 2013 [San Diego, May 2013], CYTO 2012 [Leipzig-Germany, June 2012], CYTO 2011 [Baltimore, May 2011] and CYTO 2010 [Seattle, May 2010].

- Received the "*Best Outgoing Student*" Award from the Department of Chemical Engineering at St. Joseph's College of Engineering in April 2009

- Received "*Merit Scholarship*" for the academic years 2005-2006, 2006-2007 and 2007-2008 from the Department of Chemical Engineering at St. Joseph's College of Engineering

Notable Achievements:

- One of the five finalists nominated from universities worldwide for the "*Exceptional Student Award*" at CYTO 2012 held at Leipzig, Germany in June 2012.

Memberships:

- Student Member, International Society for Advancement of Cytometry, 2010-2013

- Executive Member, Students' Chapter of the Indian Institute of Chemical Engineers, 2008-2009

Research Experience:

I am a Ph.D. graduate in Chemical Engineering with 7+ years of research experience including 3 years as postdoc in the United States of America. Currently, I am an Institute Post Doctoral Fellow in the Department of Mechanical Engineering at the Indian Institute of Technology – Madras (IITM) in Chennai, India, pursuing research on the development of microfluidic biosensors for the detection of plasma biomarkers, and

actively engaged in a collaborative project on droplet cytometry. Through graduate and postdoctoral research, I have gained experience in the design, fabrication and optimization of microfluidic devices for manipulation and analysis of particles and cells using acoustics/ultrasound and in the development of custom optical and automated instrumentation systems. As Postdoctoral Associate in the Triangle Materials Research Science and Engineering Center (MRSEC) at Duke University in Durham, North Carolina, USA until December 2016, I was actively involved in three (3) research projects. My primary project focused on the development of a hand-held acoustic trapping device for medical diagnostics in resource-poor settings. The goal of this project was to demonstrate a microfluidic immunoassay via trapping of synthetic, surface-functionalized, acoustically-tunable microparticles that was developed by our PI's group. I successfully demonstrated trapping of these synthetic microparticles against 100's of µL/min flow and subsequent staining within a capillary device and inline affinity binding of nanoparticles over trapped acoustically-responsive particles in our handheld microfluidic device, thus confirming their potential use with bead-based immunodiagnostics. Concurrently, I developed an automated cell-sorter also that used LabVIEW to interface its acoustic power generation, temperature and flow monitoring and control components. I generated codes in LabVIEW to control the independent units, and conducted experiments to study parameters that influence acoustic trapping. Besides these, I contributed to a collaborative project focused on the assembly and printing of gold nanoparticles via acoustics for potential use in medical diagnostics and electronics manufacturing. Although challenging by virtue of size, simply by using the density and compressibility dependence of the acoustic radiation force, we successfully demonstrated assembly of few 100's down to 10's of nm gold particles within 10's of seconds of acoustic actuation, and characterized such assembly using high-resolution hyperspectral imaging microscopy and scanning electron microscopy (SEM).

My interest in microfluidics and instrumentation stemmed from my research experience at the University of New Mexico (UNM), where I worked as Research Assistant during my Ph.D. program and as Post Doctoral Researcher following graduation. As graduate student, I developed acoustic microfluidic devices for high throughput flow cytometry applications. These flow cells use higher resonance modes of high frequency ultrasound to focus particles and cells into highly parallel streams. Such parallel focusing improves sample throughput which is critical for rare event analysis, for example in the detection of circulating tumor cells, where it may be required to detect one (1) abnormal cell in a population of about a billion (10^9) healthy cells. I fabricated these flow cells using different materials, which include (a) precisely machined aluminum, (b) disposable glass capillaries and (c) silicon using semiconductor microfabrication techniques such as photolithography, deep reactive ion etching (DRIE) and anodic bonding in the cleanroom. Among these, the flow cells etched in silicon provided precise focusing of particles at flow rates up to few 10's of milliliters-per-minute, which is few orders of magnitude higher in throughput than that of commercial flow cytometers. In order to use these devices for flow cytometry applications, we designed and developed custom instrumentation system that uses laser line for interrogation and high-sensitivity, high frame-rate scientific camera for acquiring fluorescence data from cells and particles focused into highly parallel streams within our flow cells. We successfully demonstrated proof-of-concept detection of fluorescent

microparticles using this system, following which it was patented and licensed to a start-up company in Albuquerque, New Mexico for commercialization. This patent was approved within three (3) years of filing.

In order to gain more experience with optical instrumentation, I continued to work with my graduate advisor following graduation on a project that was focused on developing a high sensitivity flow cytometer for nanoprotease assays. Traditional flow cytometers suffer from poor sensitivity of detection for nanoparticles and biomolecules due to large interrogation volumes presented by large beam diameters used for interrogating particles. We proposed to overcome this issue by modifying the size and geometry of the laser beam such that the interrogation volume approaches few atto (10^{-18}) liters. By integrating beam-shaping optics in the path of an ultraviolet laser source and a high-resolution digital sensor for imaging, we were able to sufficiently resolve particles few µm's in size.

Besides research, I have experience in teaching and mentoring also. In Spring 2013, I served as Teaching Assistant for the Undergraduate Chemical Engineering Thermodynamics course at UNM. I taught problems class once every week together with a fellow assistant. I held office hours to provide one-to-one guidance to students on assignments, graded weekly assignments and assisted the course instructor with correcting examination scripts. Furthermore, I mentored a couple of high school students, from September 2011 to May 2012 and June to August 2014. I trained these students on microscopy, cell staining, device fabrication and acoustics, and guided them with preparing and presenting scientific research.

Being an active researcher, I have authored journal articles covering experimental research and technology review, presented scientific findings as oral, poster and multimedia presentations at international conferences, and coordinated laboratory safety audit as chemical hygiene officer. Besides acoustic microfluidic devices, I have fabricated hydrodynamic focusing devices for flow cytometry using soft lithography techniques. Having gained experience in microfluidics, instrumentation and automation, I now wish to advance my knowledge of applied life sciences, explore research in areas beyond my expertise and develop innovative, cost-effective tools and technologies for diagnosis and treatment of critical diseases challenging global healthcare.

Publications:

1) Raj A, Austin Suthanthiraraj PP, and Sen AK, Flow dynamics through flexible microchannel and its applications in microfluidics: A review, 2018 (In preparation)

2) Reyes C, Fu L, Austin Suthanthiraraj PP, Owens CE, Shields IV CW, López GP, Charbonneau P, Wiley BJ, The limits of primary radiation forces in bulk acoustic standing waves for concentrating nanoparticles, 2017 (Submitted)

3) Austin Suthanthiraraj PP, Graves SW, Fluidics, *Current Protocols in Cytometry* 2013, 65: 1.2.1-1.2.14.

4) Austin Suthanthiraraj PP, Piyasena ME, Woods TA, Naivar MA, Lopez GP, Graves SW, One-dimensional acoustic standing waves in rectangular channels for flow cytometry, *Methods* 2012, 57(3): 259-71.

5) Piyasena ME, Austin Suthanthiraraj PP, Applegate Jr. RW, Goumas AM, Woods TA, Lopez GP, Graves SW, Multinode acoustic focusing for parallel flow cytometry, *Anal. Chem.* 2012, 84(4): 1831-39.

Patents:

1) Graves SW, Austin Suthanthiraraj PP, Shreve AP and Lopez GP. Spatially Correlated Light Collection from Multiple Sample Streams Excited with a Line Focused Light Source. Application Number: US 13/835,108, International Application Number: PCT/US2013/32025 (Approved: October 8, 2015).

Presentations:

(a) Oral Presentations (First author)

1) *Development of a microfluidic device for on-chip blood-plasma separation and determination of blood glucose levels via localized surface plasmon resonance*, Microfluidics and Lab-On-A-Chip, Mumbai, India, January 2018

2) *An extremely parallel acoustic flow cell for rapid cellular analysis*, 36th Annual Research Course in Flow Cytometry, University of New Mexico, Albuquerque, NM, USA, June 2013

3) *An extremely parallel acoustic flow cell for rapid cellular analysis*, CYTO 2012, Leipzig, Germany, June 2012

4) *Viscosity and excess volume of binary liquid mixtures at various temperatures*, Indian Chemical Engineering Congress (CHEMCON 2008), Chandigarh, India, December 2008

5) *Investigation of protease enzyme from tannery wastes using fermentation technique*, National Level Seminar for Chemical Engineering Students (FUSION-08), Anantapur, India, September 2008

6) *Medical applications of nanotechnology*, International Conference on Applied Bioengineering (iCAB 07), Chennai, India, December 2007

(b) Oral Presentations (Co-author)

1) *Configurable assembly of microparticles via acoustic standing waves*, presented by Dr. Charles W. Shields, 90th Colloid & Surface Science Symposium, Boston, MA, USA, June 2016

2) Acoustic radiation forces for the rapid and programmable assembly of microparticles and nanoparticles, presented by Dr. Charles W. Shields, ACS National Meeting and Exposition, San Diego, CA, USA, March 2016

3) *High throughput digital video flow cytometry*, presented by Dr. Jaime J. Juarez, CYTO 2014, Fort Lauderdale, FL, USA, May 2014

4) *An extremely parallel acoustic flow cytometer for rapid cellular analysis*, presented by Dr. Steven W. Graves, CYTO 2013, San Diego, CA, USA, May 2013

5) *An extremely parallel acoustic flow cell for rapid cellular analysis*, presented by Dr. Steven W. Graves at USWNet 2012, Lund, Sweden, September 2012

(c) Poster Presentations

1) *An extremely parallel acoustic flow cell for rapid cellular analysis*, Center for Biomedical Engineering (CBME) External Advisory Committee Visit, University of New Mexico, Albuquerque, NM, USA, January 2014

2) *Highly parallel multinode acoustic focusing flow cell*, CYTO 2011, Baltimore, Maryland, USA, May 2011

3) *Mesofluidic and field-based size selection of different cell types*, CYTO 2010, Seattle, Washington, USA, May 2010.

(d) Multimedia Presentation

1) *Acoustic manipulation of liposomes*, CYTO 2013, San Diego, California, CA, May 2013

Projects:

(a) Postdoctoral Research

Indian Institute of Technology – Madras (IITM)

- Development of localized surface plasmon resonance (LSPR) biosensors for the detection of biomarkers in plasma
- Development of a droplet cytometry-based cell sorter for cancer diagnostics

Duke University

- Development of Acoustofluidic Pipette for Bead-based Diagnostics in Resource-Poor Settings
- Trapping of Elastomeric, Acoustically-Tunable Microparticles and Assembly of Gold Nanoparticles using Acoustic Radiation Force within Microfluidic Devices
- Development of LabVIEW-based Automated Instrumentation System for Cell Sorting

University of New Mexico

- Development of a High-Sensitivity Flow Cytometer for Nanoprotease Assays

(b) Doctoral Dissertation

- Multinode Acoustic Systems for High Throughput Cellular Analysis

(c) Undergraduate Final-Year Project

- Process Optimization for Production of Antimicrobial Compound by Bacillus species and Scale-up Studies by Designing a Laboratory Fermentor

Activities:

- Volunteered for the Short-Term Course on Microfluidics-Based Healthcare Diagnostics and Interfacial Phenomena held in the Indian Institute of Technology – Madras (IITM) in November 2017
- Coordinated laboratory safety audit as Chemical Hygiene Officer at Duke University in May 2015

- Mentored a high school senior in the Center for Biomedical Engineering (CBME) at the University of New Mexico in Summer 2014

- Served as Judge for the Poster Presentation session during Biomedical Sciences Graduate Program (BSGP) Student Research Day at the University of New Mexico in February 2014

- Volunteered for the Center for Biomedical Engineering (CBME) External Advisory Committee Visit at the University of New Mexico in January 2014

- Volunteered for the Center for Biomedical Engineering (CBME) Open House held at the University of New Mexico in November 2012

- Mentored a high school sophomore from Albuquerque Public Schools (APS) under NSF-Harvard Partnership for Research and Education in Materials (PREM) program at the University of New Mexico from September 2011 – May 2012

- Participated in outreach activities on three occasions as part of the Partnership for Research and Education in Materials (PREM) program during Fall 2011-Spring 2012

- Member of organizing committee for the National Symposium “Jet Chem-Bio 2008” held at St. Joseph’s College of Engineering, Chennai, India in September 2008