

## Santosh Kumar Paidi

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RESEARCH INTERESTS	Raman Spectroscopy, Chemometrics, Breast Cancer, Radiation Therapy, Clinical Diagnostics	
EDUCATION	<b>Johns Hopkins University</b> , Baltimore, MD, USA Ph.D. Candidate in Mechanical Engineering Advisor: Prof. Ishan Barman	<b>Aug ‘14 - May ‘20</b> ( <i>Expected</i> )
	<b>Johns Hopkins University</b> , Baltimore, MD, USA M.S.E. in Mechanical Engineering	<b>May ‘17</b>
	<b>Indian Institute of Technology Bombay</b> , Mumbai, India B.Tech. in Mechanical Engineering Minor in Aerospace Engineering	<b>Jul ‘10 - Apr ‘14</b>
GRANTS	<b>SLAS Graduate Education Fellowship Grant</b> Project Title: Ultrasensitive detection with plasmon-enhanced Raman spectroscopy: From circulating tumor DNA analysis to cell surface glycation imaging Budget: \$100,000 ( <i>1 awarded annually</i> )	<b>Sep ‘18 - Sep ‘20</b>
HONORS AND AWARDS	Awarded <b>Tony B. Academic Travel Award</b> by Society for Laboratory Automation and Screening (SLAS). Awarded <b>Coblentz Student Award</b> by the Coblentz Society. Awarded <b>SPIE Optics and Photonics Education Scholarship</b> by SPIE - The International Society for Optical Engineering. Represented Johns Hopkins University Optical Society (OSA) Student Chapter at the <b>2018 OSA Student Leadership Conference</b> . Awarded <b>Tomas A. Hirschfeld Scholar Award</b> by Federation of Analytical Chemistry and Spectroscopy Societies (FACSS). Secured <b>third position</b> in poster competition at Optics and Photonics Conference held at Johns Hopkins University. Awarded <b>Molecular Medicine Tri-Conference Student Fellowship</b> to attend and present at the 22 <sup>nd</sup> Molecular Medicine Tri-Conference held in San Francisco. Awarded <b>Whiting School Doctoral Fellowship</b> and <b>Mechanical Engineering Departmental Fellowship</b> at JHU for the academic year 2014-15. Awarded <b>Undergraduate Research Award</b> by IIT Bombay for outstanding research in the field of Combustion.	<b>‘19 and ‘18</b> <b>‘18</b> <b>‘18</b> <b>‘18</b> <b>‘17</b> <b>‘17</b> <b>‘15</b> <b>‘14</b> <b>‘13</b>
REFEREED JOURNAL ARTICLES	<ul style="list-style-type: none"><li>• <b>Paidi SK*</b>, Diaz PM*, Dadgar S*, Jenkins SV, Quick CM, Griffin RJ, Dings RPM, Rajaram N, Barman I. "Label-free Raman spectroscopy reveals tumor microenvironmental signatures of radiation resistance" <b>Cancer Research</b>, 79(8), 2054-64, <b>2019</b>. (<i>See media section for related press coverage</i>)</li><li>• Xu W, <b>Paidi SK</b>, Qin Z, Huang Q, Yu CH, Pagaduan J, Buehler MJ, Barman I, Gracias DH. "Self-folding hybrid graphene skin for 3D biosensing", <b>Nano Letters</b>, 19(3), 1409-17, <b>2019</b>.</li></ul>	

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\*denotes equal contribution

- Li M, **Paidi SK**, Sakowski E, Preheim S, Barman I. “Ultrasensitive Detection of Hepatotoxic Microcystin Production from Cyanobacteria Using Surface-Enhanced Raman Scattering (SERS) Immunosensor”, **ACS Sensors**, 4(5), 1203-10, **2019**.
- Rizwan A\*, **Paidi SK\***, Zheng C\*, Cheng M, Fan Z, Barman I, Glunde K. “Mapping the genetic basis of breast microcalcifications and their role in metastasis”, **Scientific Reports**, 8:11067, **2018**.
- **Paidi SK\***, Rizwan A\*, Zheng C\*, Cheng M, Glunde K, Barman I. “Label-free Raman spectroscopy detects stromal adaptations in pre-metastatic lungs primed by breast cancer”, **Cancer Research**, 77(2), 247-56, **2017**.
- Pandey R, **Paidi SK**, Valdez TA, Zhang C, Spegazzini N, Dasari RR, Barman I. “Noninvasive monitoring of blood glucose with Raman spectroscopy”, **Accounts of Chemical Research**, 50(2), 264-72, **2017**.
- Siddhanta S, **Paidi SK**, Bushley K, Prasad R, Barman I. “Exploring morphological and biochemical linkages in fungal growth with label-free light sheet microscopy and Raman spectroscopy”, **ChemPhysChem**, 18(1), 72-8, **2017**. (*Journal back cover*)
- Jin Q\*, Li M\*, Polat B, **Paidi SK**, Dai A, Zhang A, Padaguan J, Barman I, Gracias DH. “Mechanical trap surface enhanced Raman spectroscopy (MTSERS) for 3D surface molecular imaging of single live cells.”, **Angewandte Chemie International Edition**, 56(14), 3822-26, **2017**.
- **Paidi SK**, Siddhanta S, Strouse R, McGivney JB, Larkin C, Barman I. “Rapid identification of biotherapeutics with label-free Raman spectroscopy”, **Analytical Chemistry**, 88(8), 4361-8, **2016**.
- Myakalwar AK, Anubham SK, **Paidi SK**, Barman I, Gundawar MK. “Real-time fingerprinting of structural isomers using laser induced breakdown spectroscopy”, **Analyst**, 141(10), 3077-83, **2016**.
- Zheng C\*, Shao W\*, **Paidi SK**, Han B, Fu T, Wu D, Bi L, Xu W, Fan Z, Barman I. “Pursuing shell-isolated nanoparticle-enhanced Raman spectroscopy (SHINERS) for concomitant detection of breast lesions and microcalcifications”, **Nanoscale**, 7, 16960-8, **2015**.
- Pandey R\*, **Paidi SK\***, Kang JW, Spegazzini N, Dasari RR, Valdez TA, Barman I. “Discerning the differential molecular pathology of proliferative middle ear lesions using Raman spectroscopy”, **Scientific Reports**, 5:13305, **2015**.
- **Paidi SK**, Bhavaraju A, Akram M, Kumar S. “Effect of N<sub>2</sub>/CO<sub>2</sub> dilution on Laminar Burning Velocity of H<sub>2</sub>-Air Mixtures at High Temperatures”, **International Journal of Hydrogen Energy**, 38(31), 13812-21, **2013**.
- Ming Li, **Paidi SK\***, Mesyngier N\*, Preheim S, Barman I. “A fluorescent and surface-enhanced Raman spectroscopic dual-modal aptasensor for sensitive detection of cyanotoxins” (*Under revision*).

#### INVITED TALKS

- “Label-free Raman spectroscopy for rapid identification of biologics”, *SLAS Ignite Academic Theater*, San Diego, USA, **2018**.
- “Probing complex problems in cancer research with Raman spectroscopy”, *Indian Institute of Technology Bombay*, Mumbai, India, **2018**.

#### CONFERENCE PRESENTATIONS

- **Paidi SK**, Rajaram N, Barman I. “Characterizing response and resistance to radiation therapy using label-free Raman spectroscopy”, *SPIE Photonics West*, San Francisco, USA, **2019**.
- **Paidi SK**, Barman I. “Mechanical Trap Surface-Enhanced Raman Spectroscopy for Live Three-Dimensional Molecular Imaging of Single Cells”, *SLAS International Conference and Exhibition*, Washington DC, USA, **2019**.
- **Paidi SK**, Barman I. “Label-Free Raman Spectroscopy Elucidates Biomolecular Response to

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\*denotes equal contribution

Radiation Therapy and Identifies Intrinsic Resistance”, *FACSS/SCIX*, Atlanta, USA, **2018**.

- **Paidi SK**, Barman I. “Real-time, label-free tracking of monoclonal antibody aggregation with vibrational spectroscopy”, *FACSS/SCIX*, Atlanta, USA, **2018**.
- **Paidi SK**, Siddhanta S, Barman I. “Label-free Raman spectroscopy for rapid identification of biologics”, *SLAS International Conference and Exhibition*, San Diego, USA, **2018**.
- **Paidi SK**, Glunde K, Barman I. “Elucidating the evolution of the pre-metastatic niche: Fresh insights into the soil and seed hypothesis of cancer metastasis with Raman spectroscopy”, *SPIE Photonics West (BiOS)*, San Francisco, USA, **2018**.
- **Paidi SK**, Glunde K, Barman I. “Label-free Raman spectroscopy for detection of breast cancer-induced pre-metastatic changes in lungs”, *Optics and Photonics Conference at Johns Hopkins University*, Baltimore, USA, **2017 (Poster)**.
- **Paidi SK**. “Mechanical trap surface-enhanced Raman spectroscopy for three-dimensional molecular imaging of single live cells”, *FACSS/SCIX*, Reno, USA, **2017**.
- **Paidi SK**, Rizwan A, Zheng C, Cheng M, Glunde K, Barman I. “Decoding breast cancer-induced stromal adaptations in pre-metastatic lungs with label-free Raman spectroscopy”, *FACSS/SCIX*, Reno, USA, **2017**.
- **Paidi SK**, Prasad R, Li M, Barman I. “Profiling the molecular pathology of ovarian cancer with plasmon-enhanced spectroscopy”, *22<sup>nd</sup> Molecular Medicine Tri-conference*, San Francisco, USA, **2015 (Poster)**.
- **Paidi SK**, Bhavaraju A, Akram M, Kumar S. “Laminar Burning Velocity of H<sub>2</sub>-N<sub>2</sub>/CO<sub>2</sub>-Air Mixtures at Elevated Temperatures”, *24<sup>th</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*, Taipei, Taiwan, **2013**.

## RESEARCH EXPERIENCE

### Quantitative Pathology using Raman Spectroscopy and Chemometrics

*Advisors: Prof. Ishan Barman, Johns Hopkins University;*

**Sep ‘14 - Present**

*Prof. Kristine Glunde, The Johns Hopkins University School of Medicine*

- Successfully demonstrated an approach featuring label-free Raman spectroscopic mapping, a protocol that focuses on multiplexed molecular changes and data analysis of spectral patterns to elucidate stromal adaptations in the pre-metastatic lungs of mouse models with primary breast tumor xenografts.
- Developed a quantitative framework for quantification of response to radiation therapy (at clinically relevant low dosages) in sensitive and resistant tumors and objective identification of resistant tumors prior to the onset of radiation therapy.
- Demonstrated the ability of regression based classification routines to improve the diagnostic capabilities of spontaneous Raman spectroscopy to match those offered by surface enhanced Raman Spectroscopy using diagnosis of major pathological states (cancerous and non-cancerous) in breast tissues.
- Employed Raman spectroscopy in conjunction with partial least squares discriminant analysis (PLS-DA) to successfully identify and differentiate closely related proliferative middle ear lesions - cholesteatoma and myringosclerosis.

### Genes Driving Formation Of Microcalcifications In Human Breast Cancer Cells

*Advisors: Prof. Ishan Barman, Johns Hopkins University;*

**Feb ‘15 - Jul ‘18**

*Prof. Kristine Glunde, Johns Hopkins University School of Medicine*

- Demonstrated that stable silencing of the Osteopontin (OPN) gene decreased the formation of hydroxyapatite in MDA-MB-231 breast cancer cells in response to osteogenic cocktail.
- Showed that breast cancer cells that had spontaneously metastasized to the lungs in a mouse model of breast cancer had largely elevated OPN levels, while circulating tumor cells in the same mouse model contained intermediately increased OPN levels as compared to parental cells.
- Confirmed the reduction of breast cancer cell migration upon OPN silencing using transwell assays.
- Observed the existence of a direct relationship between calcium deposition and the ability of

breast cancer cells to metastasize to distant organs, mediated by common genetic factors.

### **Rapid Identification of Biotherapeutics with Label-free Raman spectroscopy**

*Advisor: Prof. Ishan Barman, Johns Hopkins University*

**Oct '14 - May '2018**

- Employed label-free spontaneous and plasmon-enhanced Raman spectroscopy in conjunction with partial least squares discriminant analysis for identification of closely related human and murine antibody drugs in solution with very high specificity and accuracy.
- Rationally designed plasmonic Ag core-Au shell nanostructures to match their LSPR with excitation laser wavelength for maximal enhancement.
- Explored novel routes to measure the occupancy distribution of antibody-drug conjugates (ADCs).

### **Low Voltage Electrowetting on Dielectrics**

*Advisors: Dr. Jakub Kedzierski, Lincoln Laboratory, MIT;*

**Jul '12 - Jun '14**

*Prof. Amit Agrawal, IIT Bombay*

- Initiated electrowetting research at IIT Bombay by using nanofabrication and characterization tools in Center of Excellence in Nanoelectronics and Tata Institute of Fundamental Research (TIFR).
- Ideated a novel system of dielectric in which contact angle modulation of about 65 degrees was observed at significantly lower voltages (3V) and the contact angle saturation was observed at lower angles than those in previous studies.

### **Laminar Burning Velocities of Gaseous Fuels**

*Advisor: Prof. Sudarshan Kumar, IIT Bombay*

**May '12 - Jun '14**

- Accurately measured laminar burning velocities of H<sub>2</sub> - Air mixtures diluted with N<sub>2</sub> and CO<sub>2</sub>.
- Employed a very simple method of measurement based on flame stabilization in preheated mesoscale diverging channels.
- The experimental results were in good agreement with the CHEMKIN predictions based on various kinetic models used in the literature.

### **Blood Flow in Stenosed and Bifurcating Microchannels**

*Advisor: Prof. Amit Agrawal, IIT Bombay*

**May '11 - Jul '11**

- Fabricated micro-channels by casting PDMS on Si-wafer molds fabricated by photolithography.
- Modeled blood flow in microsystems using equivalent electric circuits and good comparison between the model and experiments was obtained.

LEADERSHIP,  
VOLUNTEER AND  
OUTREACH

### **Homewood Graduate Board, JHU**

*Role: Whiting School of Engineering Student Representative*

**Sep '18 - Present**

- Collaborated with the Krieger School Student Representative to conduct a survey across JHU for understanding the quality of feedback graduate students obtain from their faculty advisors about their progress. Discussed the findings with Vice Provost for Graduate and Professional Education as well as Assistant Deans in the context of ongoing efforts for improving the faculty-student interactions.
- Presented the need to standardize Graduate Board Oral examination across the university for discussion during the Homewood Graduate Board spring meeting.

### **Graduate Representative Organization, JHU**

*Role: Advocacy Chair*

**Feb '18 - Sep '18**

- Facilitated discussion between graduate student body and university administration about the potential formation of private police force at JHU. This conversation contributed towards the decision of moving the bill introduced to this effect in the Maryland General Assembly to an interim study.
- Collaborated with the Chairs to improve accommodations and facilities for students with disabilities at JHU. Collaborated with undergraduate advocates for disability rights to include graduate student representatives on the search committee for Director of the Office of Student Disability Services.
- Participated in the university search for the new Dean of Student Life.

- Surveyed methods to make the academic probation and dismissal procedures transparent and uniform across the university.

### **STEM Achievement in Baltimore Elementary Schools (SABES)**

*Role: Mentor*

**Oct '17 - Present**

- Assisted third grade students to complete after-school STEM projects relevant to their community.
- Guided the students to devise a material selection strategy for mitigating bursting of water pipes in their school during winter.
- Led an interactive demonstration titled 'Tumbling Tower' during the annual SABES STEM Showcase to help students understand principles of structural engineering.

### **Department of Mechanical Engineering, JHU**

*Role: Mentor*

**Sep '15 - Present**

- Represented mechanical engineering graduate students in the Whiting School's External Review Meeting.
- Represented Ph.D. students in the Mechanical Engineering Advisory Committee Meeting.
- Conducted lab tours and presented research for incoming undergraduate students and prospective graduate students.
- Participated in the organization of MechE Commencement Luncheons.

### **National Photonics Initiative (NPI)**

*Role: Volunteer*

**Apr '18**

- Participated in NPI's Capitol Hill Day visits to advocate for science, optics and photonics and to educate members of Congress about the work happening in their districts in optics and photonics.
- Visited offices of the members of Congress and urged to maintain current funding levels, resist any spending cuts and support, at a minimum, 4 percent growth in funding for the nation's science research.

### **Barman Laboratory**

*Role: Lab Safety Captain*

**Apr '18 - Present**

- Oversee safety of a rapidly expanding lab by formulating and ensuring adherence to safe operating procedures.
- Ensure appropriate safety training of new lab members and periodic re-certification of biosafety cabinet and other equipment.

### **Maryland Science Olympiad State Finals**

*Role: Volunteer*

**Apr '18**

- Helped with the logistics of sessions on optics and the awards ceremony.

### **Johns Hopkins Center for Talented Youth**

*Role: Volunteer*

**Jun '17**

- Delivered a lecture about emerging optical tools for applications in biology and medicine.
- Conducted a lab tour to demonstrate how such tools are being used in real labs to solve problems ranging from biologics identification to cancer metastasis.

### **QEA Eduventures Pvt Ltd**

*Role: Manager, Seminar Series*

**Feb '12 - Mar '14**

- Led a team of over 25 students to conduct seminars in schools across India on career planning and competitive exams.
- Raised a sponsorship of over INR 1 million to successfully conduct these seminars.

## **TEACHING**

Course Instructor for **EN.500.111.05: Introduction to Biomedical Optics** at JHU, Fall **2019** (*scheduled*)

Guest speaker for **Engineerig Innovataion Special Lecture** at JHU, Summer **2019** (*scheduled*)

Participated in a 3-day **Teaching Institute** organized by JHU Teaching Academy, Summer **2019**

Course Instructor for **EN.500.111.33: Quantitative Spectroscopy and Imaging in Biology and Medicine** at JHU, Fall **2018**

Teaching Assistant for **EN 530.441: Introduction to Biophotonics** at JHU, Spring **2018**

Teaching Assistant for **EN 530.473: Molecular Spectroscopy and Imaging** at JHU, Fall **2017**

Teaching Assistant for **EN 530.441: Introduction to Biophotonics** at JHU, Spring **2016**

#### SELECTED MEDIA COVERAGE

- “Imaging tool helps doctors predict how cancer will respond to radiation”, *Inside Science News Service*, **2019**.
- “Raman spectroscopy predicts radiation resistance”, *Physics World*, **2019**.
- “Detecting differences between radiation-sensitive and resistant tumors”, *Technology Networks*, **2019**.
- “Imaging technique finds differences between radiation-sensitive and resistant tumors”, *Science Daily*, **2019**.
- “Shedding light on resistance to radiation therapy”, *The Hub at Johns Hopkins*, **2019**.
- “Method may predict if radiation will work on tumors”, *Futurity: Research News*, **2019**.
- “Shedding lightliterally on resistance to radiation therapy”, *Medical Xpress*, **2019**.
- “2018 SLAS Graduate Education Fellowship Grant recipient fosters SERS diagnostic assay concept”, *SLAS Electronic Laboratory Neighborhood*, **2018**.

#### PROFESSIONAL ACTIVITIES

**Associate Editor:** Journal of Emerging Investigators

**Journal Reviewer:** Cancer Research, Clinical Cancer Research, Light: Science & Applications, Journal of Biomedical Optics, Optical Engineering, Journal of Medical Imaging, Journal of Emerging Investigators, Kidney International<sup>†</sup>, Analytica Chimica Acta<sup>†</sup>, ASME Journal of Medical Devices<sup>†</sup>

**Member:** American Association for Cancer Research (AACR), SPIE (The International Society for Optical Engineering), The Optical Society (OSA), The Coblentz Society, Society for Laboratory Automation and Screening (SLAS)

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<sup>†</sup>In collaboration with advisor