OMB No. 0925-0001 and 0925-0002 (Rev. 10/2021 Approved Through 09/30/2024)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Lars B. Laurentius

eRA COMMONS USER NAME (credential, e.g., agency login): LarsLaurentius

POSITION TITLE: Research Assistant Professor, University of Utah and Chief Technology and Product Development Officer for Sentiomed

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)

| INSTITUTION AND LOCATION | DEGREE(if applicable) | Completion DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| University of Alberta, Edmonton, Canada | B.Sc. | 04/2006 | Chemistry |
| University of Alberta, Edmonton, Canada | Ph.D. | 10/2012 | Analytical Chemistry |
| University of Alberta, Edmonton, Canada | Postdoc | 08/2013 | Surface Chemistry / Biosensing |
| University of Utah, Salt Lake City, USA | Postdoc | 08/2018 | Nanotechnology / Sensors |
|  |  |  |  |

**A. Personal Statement**

My research focus is on the development of sensors for biomedical applications. I have over 15 years of experience in analytical chemistry, surface chemistry, immunological chemistry, microfabrication, nanotechnology, and detection modalities. My expertise provide the foundation for designing and implementing health-related tests that are both sensitive and user-friendly. As part of my training at the University of Alberta and University of Utah, I worked on aspects of assay performance that include surface immobilization of biological active recognition elements, micro and nanofabrication procedures, overcoming biocompatibility challenges, sample pretreatment, and reducing non-specific binding for improving assay operations in respect to analysis time, portability, ease-of-use, specificity, and sensitivity.

Ongoing and Completed Research:

1. Total amount: $85,000, Funding agency: Blackrock Neurotech

Solicitation: Industry Sponsored Project.

Proposal title: BRN NeuraLace 2023.

Award year(s): (10/01/2023 to 09/30/2024)

Role: Co-Principal Investigator

1. Total amount: $47,000, Funding agency: DARPA

Solicitation: Strengthen.

Proposal title: NOCICEPT: Novel and Conventional Interventions for Cognitive and Emotional Flexibility in Patient Trauma.

Award year(s): (10/01/2023 to 04/30/2027)

Role: Co-Principal Investigator

1. Total amount: $30,000, Funding agency: University of Utah

Solicitation: 1U4U.

Proposal title: 1U4U Magda FY23 An Inexpensive Point-of-Care Sensor for Monitoring Blood Acetaldehyde

Concentration.

Award year(s): (06/01/2023 to 12/31/2024)

Role: Co-Principal Investigator

1. Total amount: $131,966, Funding agency: PIVOT Center Ascender Funding (University of Utah)

Solicitation: Ascender Grant.

Proposal title: Portable Surface-Enhanced Raman Scattering (SERS) Readout Technology to Screen for Congenital Cytomegalovirus Infection.

Award year(s): (10/06/2022 to 04/30/2024)

Role: Principal Investigator

1. Total amount: $165,473, Funding agency: Sentiomed, Inc.

Solicitation: Industry Sponsored Project.

Proposal title: Hyaluronic Acid Hydrogels.

Award year(s): (09/01/2021 to 04/30/2024)

Role: Principal Investigator

1. Total amount: $255,940, Funding agency: NSF (2212977)

Solicitation: SBIR Phase I.

Proposal title: SBIR Phase I: Sentiomed Injectable 14-day Biodegradable Glucose Sensor System.

Award year(s): (8/15/2022 to 08/15/2023)

Role: Co-Principal Investigator

1. Total amount: $56,758, Funding agency: Nanophilic, LLC.

Solicitation: Industry Sponsored Project.

Proposal title: Rapid COVID-19 antigen Test kit Evaluation and Comparison.

Award year(s): (1/24/2022 to 2/28/2023)

Role: Principal Investigator

1. Total amount: $255,781, Funding agency: NIH (R43NS127733)

Solicitation: SBIR Phase I.

Proposal title: Passive intracranial pressure sensor for hydrocephalus shunts and cranioplasty implants with ultrasound readout.

Award year(s): (4/01/2022 to 03/31/2023)

Role: Co-Investigator

1. Total amount: $67,916, Funding agency: Diabetes Research Center Washington University (P30 NIH).

Solicitation: Washington University / Utah DRC Pilot and Feasibility Award.

Proposal title: Biodegradable Glucose Sensors with Ultrasound Readout.

Award year(s): (12/01/2021 to 11/30/2022)

Role: Principal Investigator

1. Total amount: $37,500, Funding agency: Office of the Vice President for Research (University of Utah)

Solicitation: Special Emphasis: Emerging COVID-19/SARS-CoV-2 Research seed grant program.

Proposal title: Multiplexed Detection of COVID-19/SARS-CoV-2 Biomarkers for Diagnosis and Surveillance. Award year(s): (05/01/2020 to 04/30/2021)

Role: Principal Investigator

1. Total amount: $6,000, Funding agency: NSF through the University of Utah

Solicitation: I-CORPS.

Description: Combining several aspects into a single dental appliance to combat caries.

Award year(s): 0.5 year (11/01/2021 to 04/30/2022)

Role: Principal Investigator

1. Total amount: $52,500, Funding agency: Industry Research Contract (Sprightly Health, Inc.)

Solicitation: Industrial sponsored research.

Proposal title: Design, develop, and test microfluidic system implementation for SARS-CoV-2 antigen detection. Award year(s): 0.25 year (02/15/2021 to 04/30/2021)

Role: Co-Investigator

**B. Positions, Scientific Appointments, and Honors**Positions and Employment

2012-2013 Postdoctoral Fellow, Department of Chemistry and National Institute for Nanotechnology, University of Alberta, Canada

2013-2018 Postdoctoral Researcher, Nano Institute of Utah, University of Utah

2018-Present Research Assistant Professor, University of Utah, Dept. of Electrical and Computer Engineering

2021-Present Chief Technology and Product Development Officer, Sentiomed, Inc., Salt Lake City, USA

Professional Memberships and Review Panels

* University of Utah Academic Appeals and Misconduct Committee (3-year term ending 08/1/2025)
* University of Utah College of Engineering Safety Organizing Committee for laboratory safety
* University of Utah Student Fee Study Abroad Scholarship Committee (current)
* Emergency Response Coordinator for the Sorenson Molecular Biotechnology Building, University of Utah (current)
* American Chemical Society - **Member**
* University of Utah Postdoctoral Association – **Secretary** (2015-2017)
* ***Ad hoc* Reviewer** for BMC Infectious Diseases, Sensors & Actuators: B. Chemical (Elsevier), Analyst (Royal Society of Chemistry), ACS Applied Materials & Interfaces (American Chemical Society), ACS Sensors (American Chemical Society), ACS Nano (American Chemical Society), ACS Omega (American Chemical Society), IEEE Sensors, IEEE Engineering in Medicine and Biology Society, ACS Langmuir, and Nature Communications
* **Selection Committee Member** for the 2015 Distinguished Mentor Award, University of Utah, USA
* **Poster Judge** for the 2018/2019/2020 Undergraduate Research Symposium, University of Utah, Salt Lake City, UT, USA
* **Poster Judge** for the 2015 Postdoc Appreciation Day Event at the University of Utah, USA
* **Poster Judge** for the 2014 nanoUtah Conference & Exhibition in Salt Lake City, UT, USA

Honors

 2002 Alexander Rutherford Scholarship

 2002 University of Alberta Academic Excellence Scholarship

 2003 Mildred Rowe Weston Memorial Scholarship

 2004 Jason Lang Scholarship (2004-05)

 2005 Natural Sciences and Engineering Research Council of Canada Undergraduate Student Research Award

 2005 American Chemical Society Undergraduate Analytical Award

 2006 Society of Chemical Industry Merit Award

 2010 56th International Conference on Analytical Sciences and Spectroscopy Oral Presentation Award

 2010 93th Canadian Chemistry Conference and Exhibition Graduate Student Poster Award

 2011 Department of Chemistry, University of Alberta CHEM 10X Teaching Assistant Excellence

 2011 Graduate Student Association, University of Alberta Professional Development Grant

 2011 Profiling Alberta’s Graduate Student Award, University of Alberta

1. 95th Canadian Chemistry Conference and Exhibition Graduate Student Poster Competition Award

2016 Office of Postdoctoral Affairs, University of Utah, Travel Award for Conference Presentation

**C. Contributions to Science**

**1. Diagnostic test development for infectious disease biomarkers**

More recently at the University of Utah, I have been heavily involved in the development and testing of a high-throughput immunoassay platform for detecting tuberculosis (TB). There is a need to develop new approaches to test for TB infection in resource-limited areas of the word where standard techniques such as bacterial culturing are impractical. This work leveraged my extensive experience in designing, developing, and testing sensors for healthcare related challenges. The project resulted in excellent agreement of our new assay platform compared to reference techniques for a validation study that included TB-positive and TB-negative patient samples. In addition, I contributed to the field by developing sample pretreatment schemes for the important TB marker, lipoarabinomannan, which is immuno-complexed in biological fluids.

1. Lambert CJ, Jayamohan H, Gale BK, **Laurentius LB**, Patel D, Hansen M, Mahmood T, Sant HJ. “Electrochemical Detection of SARS-CoV-2 Using Immunomagnetic Separation and Gold Nanoparticles on Unmodified Screen-Printed Carbon Electrodes”. *Applied Sciences*. **2023**; 13(18):10007.
2. **L. B. Laurentius**, et al. (2023). Chip-based Nanotechnology in the Molecular Pathology Laboratory and Beyond. In W. Coleman and G. Tsongalis (Eds.), *Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing (2nd ed., chapter 46),* **2023.** Academic Press.
3. Eamonn Clarke, Ryan Robinson, **Lars B. Laurentius**, and Marc D. Porter, “Proteinase K Pretreatment for the Quantitative Recovery and Sensitive Detection of the Tuberculosis Biomarker Mannose-Capped Lipoarabinomannan Spiked into Human Serum”, *Analytical Chemistry* **2023**, 95, 24, 9191-9198.
4. **Laurentius, L.B.**, Crawford, A.C., Mulvihill, T.S., Granger, J.H., Robinson, R., Spencer, J.S., Chatterjee, D. Hanson, K.E., and Marc D. Porter. Importance of specimen pretreatment for the low-level detection of mycobacterial lipoarabinomannan in human serum. *Analyst*, **2017**, *142*, 177-185.
5. Owens, N.A., Young, C.C., **Laurentius, L.B.**, De, P., Chatterjee, D., and Marc D. Porter. Detection of the tuberculosis biomarker mannose-capped lipoarabinomannan in human serum: impact of sample pretreatment with perchloric acid. *Analytica Chimica Acta*, **2019**, *1043*, 140-147.
6. Amin, A.G., De, P., Spencer, J.S., Brennan, P.J., Daum, J., Andre, B.G., Joe, M., Bai, Y., **Laurentius, L.B.**, Porter, M.D., Honnen, W.J., Choudhary, A., Lowary, T.L., Pinter, A., and Delphi Chatterjee. Detection of lipoarabinomannan in urine and serum of HIV-positive and HIV-negative TB suspects using an improved capture-enzyme linked immune sorbent assay and gas chromatography/mass spectrometry. *Tuberculosis*, **2018**, *111*, 178-187.

The work also included the initial assessment of translating the approach to a field-deployable platform using a handheld Raman spectrometer.

1. Owens, N.A., **Laurentius, L.B.**, Porter, M.D., Li, Q., Wang, S., and Delphi Chatterjee. Handheld Raman spectrometer instrumentation for quantitative tuberculosis biomarker detection: a performance assessment for point-of-need infectious disease diagnostics. *Applied Spectroscopy*, **2018**, *72(7)*, 1104-1115.

**2. Biomedical sensor development for monitoring diabetes**

Recently, I have been working on several promising sensor concepts using smart hydrogels that can be highly useful for monitoring blood glucose levels. Hydrogels are three-dimensional networks of cross-linked polymeric structures that can absorb a significant amount of water. These hydrogels can be used as injectable sensing elements for monitoring glucose levels in the body and can be designed to become biodegradable. I am working on a sensing approach that measures changes in the hydrogel volume response to changing glucose levels using medical imaging ultrasound, which provides a platform for non-harmful remote sensing. The benefits of this technology are (1) intermittent or continuous in vivo monitoring of glucose, (2) biodegrading hydrogels that do not have to be removed at the end of their useful lifespan, (3) injectable hydrogel sensing components are completely passive (no electronics) minimizing potential challenges with encapsulation failure or sensor breakage, and (4) elimination of the need for surgical insertion/extraction.

1. S. Boroomand, N. Farhoudi, P.D. Kairy, C.F. Reiche, F. Solzbacher, J.J. Magda, and **Lars B. Laurentius,** “Hydrogel-based Sensor development and applications.” PittCon Conference & Expo, March 18-22, 2023, Philadelphia, Pennsylvania, USA. **Symposium Organizer and Invited Speaker.**
2. N. Farhoudi, **L. B. Laurentius**, J. J. Magda, C. F. Reiche, and F. Solzbacher; “In vivo Monitoring of Glucose using Ultrasound-induced Resonance in Implantable Smart Hydrogel Microstructures”, *ACS Sensors*, **2021**, 6 (10), 3587-3595.
3. N. Farhoudi, H.-Y. Leu, **L. B. Laurentius**, J. J. Magda, F. Solzbacher and C. F. Reiche: “Smart Hydrogel Micromechanical Resonators with Ultrasound Readout for Biomedical Sensing”, *ACS Sensors*, **2020**, 5 (7), 1882-1889.
4. **L.B. Laurentius**, N. Farhoudi, J. Magda, C.F. Reiche, and F. Solzbacher “Micromechanical Resonators for

Ultrasound-Based Sensors.” 239th ECS Meeting with the 18th International Meeting on Chemical Sensors (IMCS), May 30-June 3, 2021, Digital Meeting. Talk.

1. **L.B. Laurentius**, C.F. Reiche, F. Solzbacher, and M. Porter “A closer look at the design requirements and challenges of point-of-care tests for disease detection.” PittCon Conference & Expo, March 5-9, 2021, Atlanta, GA (Virtual). Symposium Organizer and Invited Speaker.

**3. Surface modification and incorporation of nanoparticles in assays**

I contributed to the field of surface modification by demonstrating the modification of planar surfaces and nanostructures using diazonium salt chemistry to form stable, covalently attached multilayered films that can be used to protect the surface and/or serve as attachment points for biomolecules. The work included organic synthesis of diazonium salts for modification of gold, silver, carbon, and titanium surfaces; electrochemical and spontaneous grafting of organic layers on conductive surfaces; and extensive characterization using spectroscopy and microscopy techniques. The extension of this research led to the application of gold nanoparticles as extrinsic labels in sandwich immunoassays utilizing both SERS and UV-vis detection schemes, which served as my foundation in biosensor development.

1. **Laurentius, L.B.**, Owens, N.A., Park, J., Crawford, A.C., and Marc D. Porter. Advantages and limitations of nanoparticle labeling for early diagnosis of infection. *Expert Review of Molecular Diagnostics*, **2016**, *16(8)*, 883-895.
2. **Lars Laurentius**, Jane Cao, and Mark T. McDermott, *“Localized surface plasmon resonance labels in bioassays,*” 85th ACS Colloid and Surface Science Symposium **2011**, Montreal, QC.
3. Qian, H., **Laurentius, L.**, and Ray F Egerton, Artefacts Induced on Soft Layer of Hybrid Metallic Nanoparticles in TEM. *Microscopy and Microanalysis*, **2015**, *21 (S3)*, 1551-1552.
4. Chizari, K., Vena, A., **Laurentius, L.**, Sundararaj, U. The effect of temperature on the morphology and chemical surface properties of nitrogen-doped carbon nanotubes. *Carbon*, **2014**, *68*, 369-379.
5. **Laurentius, L.**, Stoyanov, S.R., Gusarov, S., Kovalenko, A., Du, R., Lopinski, G.P., and Mark T. McDermott. Diazonium-derived aryl films on gold nanoparticles: Evidence for a carbon–gold covalent bond. *ACS Nano*, **2011**, *5*, 4219-4227.