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Integrated Plasmofluidic Sensors for the Detection of Pathogens and Hazardous Substances

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The amalgamation of optics and fluidics, a field known as optofluidics, has motivated the development of nanostructures with nanoplasmonic and nanofluidic abilities. Through the extreme confinement of the local electromagnetic field or through local electrokinetic schemes, some nanoplasmonic structures can be used for the manipulation and trapping of micro- and nanoscopic objects in their near vicinity. These plasmofluidic structures have also been the source for the development of label-free sensors that can operate in real time. Metallic nanoparticles (NPs) and arrays of subwavelength apertures on thin metals support surface plasmon resonance (SPR). Flow-through nanohole arrays (NHA), specifically, enable sensing in transmission mode with straightforward collinear optics, which has motivated their use for the label-free detection of cancer biomarkers, viruses, and bacteria. In addition to the optical phenomena, flow-through NHA can also promote local electrokinetic forces that can lead to the assembly of complex structures with higher local enhancement, i.e. nanoconfinement, of the electromagnetic field. Surface-enhanced Raman scattering is a powerful plasmonic-based technique that provides highly resolved vibrational information of chemicals and biological specimens with exceptional sensitivity. SERS-based detection schemes have become more amenable to be interfaced with optics in order to create all-in-one handheld devices that can be deployed in situ. Still, the fabrication of detailed nanostructures that promote high plasmonic enhancement is challenging, and the creation of metallic nanostructures using microelectrodes and other miniature structures has been a viable alternative. In this talk, I will present fully integrated sensors based on plasmofluidic and complex nanostructures that have been developed in the QuSENS Lab at Queen's University and their potential in (bio)sensing applications.

Carlos Escobedo is a Professor in the Department of Chemical Engineering, with cross-appointment to the Department of Chemistry at Queen's University and the Department of Physics and Space Science at the Royal Military College of Canada. He received a B.Sc. from the National University of Mexico, an M.A.Sc. from the University of Toronto, and a Ph.D. from the University of Victoria. He was an NSERC postdoctoral fellow at the Bioengineering Laboratory at ETH Zürich, Switzerland. He has four years of experience in the biomedical R&D industry, working for Innovamedica as Head of Mechanical Engineering. He joined Queen's University in May 2013; he served four years as Chair of Nanotechnology and Microfluidics at the Canadian Society for Mechanical Engineering. He is the recipient of an Ontario Early Researcher Award, a Queen's Excellence in Research Award, and was honored with TD Bank's 10 Most Influential Hispanic Canadians Award, which recognizes 10 outstanding Hispanic-Canadians from across Canada. His research focuses on the development of nanostructured (bio)sensors and microfluidic platforms for analytical applications in biomedicine, chemistry, and telecommunications.

Faculty Host: Prof. Arturo Ponce