

## **Silicon Photonics: a New Approach to Label-Free Molecular Sensing**

### **Biography**

Adam Densmore received the B.Sc. degree in physics in 1997 from the University of Ottawa. He received the Ph.D. degree in engineering physics from McMaster University in 2001, for his work on quantum-well waveguide photodetectors, wavelength monitoring devices for WDM systems and fibre optic sensors. From 2001 to 2005, he was part of the research team at MetroPhotonics, Inc., that first commercialized photonic integrated circuits containing echelle grating wavelength demultiplexers and active waveguide devices. In June 2005, he joined the Optoelectronic Devices Group at the National Research Council Canada, where his research interests now include silicon-based integrated optics, nanophotonics and biosensors. He has authored over 80 scientific publications in the field of photonics.

### **Summary**

The demand for new optical biosensing technologies is growing at a rapid pace driven by the need for improved medical diagnostic equipment, increased food and water safety, genomic screening, drug discovery and many related applications. The advantages that integrated optics offers for these purposes have been widely recognized. These include the ability to fabricate compact sensor arrays, the potential for integration of optical, electrical and fluid handling functionalities on a single chip, reduced consumed sample volumes, and the existence of established semiconductor manufacturing infrastructure. In this presentation, our progress developing molecular sensors using silicon-on-insulator photonic wire waveguides is discussed. The unique optical guiding characteristics of these high-index-contrast submicron structures are engineered to achieve large evanescent field strength in a region near the waveguide surface for maximized sensor response to molecular binding events. The sharp bend radius achievable with photonic wire waveguides is also shown to enable the formation of unique and compact optical circuit geometries that are compatible with commercial microarray spotting tools used for receptor/probe immobilization. New optical biochips are then demonstrated that contain arrays of silicon photonic wire sensors and monolithically integrated microfluidic channels that are capable of providing simultaneous, real-time monitoring of different molecular binding reactions with extremely high sensitivity.