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Silicon photonic crystal based open sensors for high throughput multiplexed diagnostics in medicine and environmental sensing

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The unique property of slow light in photonic crystal (PC) waveguides has enabled novel miniature chip-integrated optical devices over the past decade. When integrated with a slot which further confines the light, PC slot waveguides enable enhanced interaction between slot waveguides and any material filling the slot. In on-chip optical interconnects, this property has led to demonstrations of 1000 pm/V electro-optic coefficients. 300αm long PC slot waveguides have demonstrated the capability to selectively detect volatile organic compounds such as xylene and trichloroethylene in water down to sub-10 ppb concentrations via near-infrared absorption signatures. In air, PC slot waveguides detect 100 ppm of methane via near-infrared absorption spectroscopy on-chip. When PC waveguides are coupled to high quality factor PC microcavities, optical trapping by the high-Q microcavities makes the platform highly sensitive to changes in the refractive index of the ambient in the vicinity of the PC microcavity. Label-free biosensors were demonstrated with the highest sensitivities (down to 1 femto-molar) amongst all on-chip and off-chip optical technologies with the highest miniaturizaton.

In this talk, we will present our recent work on extreme sensitivity PC microarrays and their applications in high throughput, simultaneous and multiplexed *in-vitro* diagnostics of lung cancer and breast cancer, with small sample volumes. We will also present our work on the PC slot waveguide platform in environmental sensing in the mid-infrared. We demonstrate that the PC open sensor platform is extremely versatile and showcase its potential for high throughput multiplexed diagnostics across several scientific and technical disciplines.

Biography

Ray T. Chen is a Professor in the Department of Electrical and Computer Engineering at The University of Texas Austin, and holds the Cullen Trust for Higher Education Endowed Professorship in Engineering. From 1988 to 1992, he worked as a research scientist, manager, and director of the Department of Electro-Optic Engineering at the Physical Optics Corporation in Torrance, California. He served as the CTO, founder, and chairman of the Board of Radiant Research, Inc. from 2000 to 2001, where he raised 18 million dollars A-Round funding to commercialize polymer-based photonic devices involving over twenty patents, which were acquired by Finisar in 2002, a publicly traded company in the Silicon Valley (NASDAQ:FNSR). He also serves as the founder and chairman of the Board of Omega Optics Inc. since its initiation in 2001. Omega Optics has received over five million dollars in research funding. His research work has been awarded over 100 research grants and contracts from such sponsors as DOD, NSF, DOE, EPA, NIH, NASA, the State of Texas, and private industry.

Chen's group at UT Austin has reported its research findings in more than 650 published papers, including over 85 invited papers. He holds 20 issued patents. He has chaired or been a program-committee member for more than 100 domestic and international conferences. He has served as an editor, co-editor or coauthor for over twenty books and special issues.

He is a fellow of IEEE, OSA, and SPIE. He was the recipient of the 1987 UC Regent's Dissertation fellowship and the 1999 UT Engineering Foundation Faculty Award, for his contributions in research, teaching and services. He was also the recipient of the 2008 IEEE Teaching Award, and the 2010 IEEE HKN Loudest Professor Award. He was elected as an Honorable Citizen of the city of Austin in 2003.

During his undergraduate years at the National Tsing Hua University, he led the 1979 university debate team to the Championship of the Taiwan College-Cup Debate Contest. He has supervised and graduated 39 Ph.D. students from his research group at UT Austin.

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