High Performance Optical Sensor for Unity Confinement of Light (2018-009)

Inversely processed mesoporous silicon rib-type waveguides with utility confinement factors for surface adlayer biosensing

Market Overview

This wave-guide biosensor comprised of a multilayer porous silicon (pSi) nanomaterial near 100% (unity) confinement of light using a simple inverse processing technique for high performance, low cost porous silicon photonics. The global market for biosensors is projected to reach $20.7 billion USD by 2020, driven by the emergence of new technologies, the growing need to manage health issues such as diabetes, and robust demand from new application areas. Hence, there is a continued need for the development of high performance sensors, featuring improved optical interaction (higher sensitivity and lower LOD), and low cost. Clemson University researchers have developed a multilayer porous silicone (pSi) wave-guide sensor using a low-cost fabrication approach to achieve a high sensitivity, low limit of detection (LOD) and near unity confinement of light.

Technical Summary

This pSi waveguide technology supports high surface adlayer sensitivity, 100x greater than conventional silicon waveguides, which are typically on the order of ~1% to ~5% within certain active sensing regions. The pSi is an effective biosensing platform, capable of achieving a high sensitivity and low limit of detection (LOD) in a variety of optical configurations spanning thin films, multilayers, and waveguides. It offers the prospect of achieving the smallest device size (highest density) combined with an ultra-sensitive and fast response owing to the shallow sub-surface dimension of the core sensing region. Fabrication of the device is enabled by a simple yet unique inverse processing technique, which offers the potential to reach revolutionary device performance per unit cost, impacting disciplines such as data communications (i.e. $/Gbps/W) and medical diagnostics ($/limit of detection LOD).

Application
Advanced Materials; Medical Diagnostics

Development Stage
Proof of Concept

Advantages
- Porous material is designed to have a multilayer rib-type waveguide geometry, enabling achievement of a near 100% (unity) confinement of light in the active sensing region
- Novel inverse processing technique is used, enabling sensitivity more than 100x higher than conventional waveguides at a 10x reduction in cost
- Unique pSi fabrication, offering flexibility to perform porous nanomaterial synthesis (i.e. porous silicon anodization) either at the wafer-scale or at the chip-scale after wafer dicing

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional Provisional Utility	United States	62/768,217 62/803,745 16/561,093	NA	2018-009	Dr. Judson Ryckman Gabriel D. Allen William F. Delaney

About the Inventors

Dr. Judson Ryckman

Assistant Professor of Electrical and Computer Engineering at Clemson University

Dr. Judson Ryckman joined Clemson University as an Assistant Professor of Electrical and Computer Engineering in fall of 2016 and serves as the Founder and Director of the Nanophotonics Laboratory. He received his B.E. and Ph.D. degrees in electrical engineering in 2008 and 2013, respectively, from Vanderbilt University. Prior to joining the Clemson faculty in the fall of 2016, Ryckman worked at Intel Corporation as a Research Scientist in Intel's Silicon Photonics division. Currently, he serves on the committee of technical conferences such as IEEE Optical Interconnects and is a reviewer for numerous journals published by IEEE and OSA. Ryckman was recently recognized as a Clemson University early-career awardee for his novel research and teaching ideas, both strong indicators of a promising career and has multiple patent applications in progress. Dr. Ryckman's current research focuses on the development and application of photonic platforms to solve problems in areas of sensing, biomedicine, food-safety, and computing/communications.

For more information on this technology contact:

Andy Bluvas
Technology Commercialization Officer

E: bluvasa@clemson.edu
P: (864) 656-5157