Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

Coulter Seminar Series Presents

"Perspective on optical biosensors: Evolutionary and quantum leaps"

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Frances S. Ligler is the Ross Lampe Distinguished Professor of Biomedical. Prior to joining NC State and UNC Chapel Hill in 2013, she was at the U.S. Naval Research Laboratory for 28 years, during the last 18 of which she was the U.S. Navy Senior Scientist for Biosensors and Biomaterials. She earned a B.S. from Furman University and both a D.Phil. and a D.Sc. from Oxford University. She has over 400 full-length publications and patents, which have led to eleven commercial biosensor products and have been cited over 20000 times with H=83 (Google Scholar). She was elected an SPIE Fellow in 2000, member of the National Academy of Engineering in 2005, a Fellow of AIMBE in 2011, a Fellow of AAAS in 2013, a Fellow of the National Academy of Inventors in 2016, and an Honorary Member of the Hellenic Society for Nanotechnology in Health Sciences in 2017. In 2003, she was awarded the Presidential Rank of Distinguished Senior Professional by President Bush. In 2012, she was awarded the Presidential Rank of Meritorious Senior Professional by President Obama. In 2014 and 2018, she was awarded honorary doctorates from the Agricultural University of Athens, Greece and Furman University, respectively. She is a 2017 inductee of the U.S. National Inventors Hall of Fame, honored for her invention of portable optical biosensors.

ABSTRACT

The definition of an optical biosensor includes a recognition molecule or molecular complex that generates an optical signal and a portable optoelectronic device that measures the signal. Conventionally, the recognition molecule is immobilized on an optically active surface that generates a signal upon target binding. That signal can be a change in color, fluorescence, optical density, frequency or other optical parameter. The explosion of nanoparticles and dyes for intracellular use confused the definition of what constitutes a biosensor. Many investigators referred to these sensing materials, especially those in nanoparticle form, as biosensors--even when the signal had to be evaluated using a laboratory microscope. The requirement for a portable system blurred. Then cell phone cameras and CMOS imagers replaced the big microscopes, and the readout system once again became portable. Looking at these changes from the perspective of decades of development of optical biosensors is intriguing. Instead of a requirement to add a sample to a biosensor, we can now add our recognition molecules to the sample and detect spectral changes using optics with imaging or spectrometry. Most importantly, the detector can be both portable and remote from the recognition molecules and without any direct contact with the sample.This geometric paradigm opens up an entire new range of measurements for optical biosensors. For the first time, we can envision continuous, long-term measurements in living cells, three-dimensional tissues, and even intact animals. We no longer need to extract, fix or terminate living organisms in order to perform functional measurements. Furthermore, imaging capabilities suggest that we can analyzed larger areas, such as thousands of cells in complex arrangements, simultaneously, without generating "average values".

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