Newport Motion Advances Tunable Photonic Crystal Biosensors Research

Markets: Life and Health Sciences, Research
Application: Drug development, Virus detection, Biological sensing.

The frontiers of biomedical research offer a new promise of lower cost, more efficient medical diagnostic tools in miniaturized form. Researchers at the Stanford Nanofabrication Facility at Stanford University have been leading the development of a new bio-sensing technique based on photonic crystal nanostructures. This technique allows portable diagnostic devices that historically relied upon labor-intensive, slow and expensive bulk optics laboratory techniques, as found in many hospitals and clinics.[1] These bio-sensors can be used across a broad spectrum of applications for detection and analysis of biomolecules in gas or liquid solutions for drug development or point-of-care diagnostics.

Photonic crystal slab resonators are periodically patterned nanostructures that yield guided resonance modes to amplify the interaction of biological matter with incident light. By monitoring the optical output, local sensing of biomolecules is achieved.

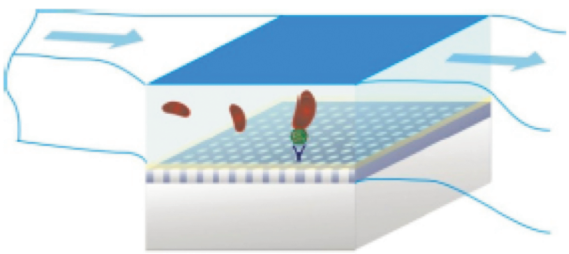

Figure 1: Sensing with a resonant photonic crystal slab

Since the biomolecular/photon interactions of interest are often characterized at the nanometer scale, the experimental setup requires position sensitivity at the sub-micron scale for alignment between an external light source, a fiber-coupled spectrometer or detector, and the photonic crystal slab resonator. The photonic crystal is mounted on a 2D scanning platform with motorized actuators provided by Newport.

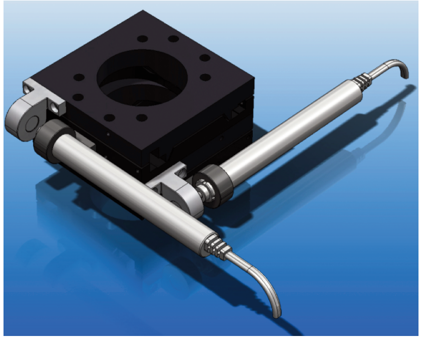

Figure 2: 426A Stage Stack with CONEX-TRA25CC

The application uses 426A crossed-roller bearing linear stages mounted in an XY stack configuration driven by two CONEX-TRA25CC integrated actuators with CONEX controllers. TRA series actuators are capable of minimum incremental motion of 100 nm for scanning across the photonic crystal array. Once an optimal spot is identified on the sample, light output is measured by a fiber probe mounted underneath the sample, through the open aperture of the 426A stage. The biomolecules on the photonic crystal slab surface shift the optical transmission spectrum, while the recorded data on the spectrometer is correlated with position information read by encoders in the TRA series actuators.

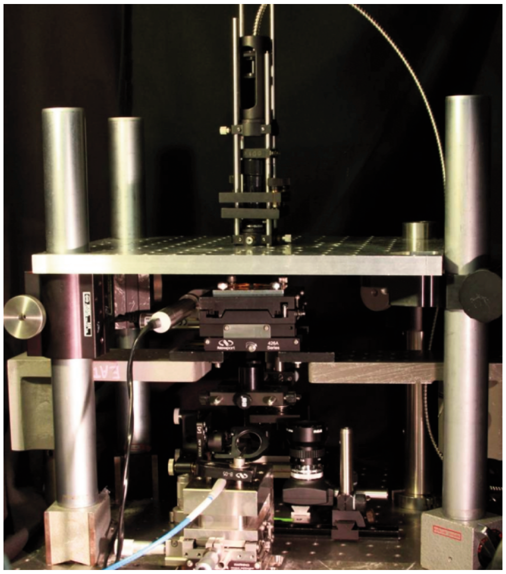

Figure 3: The experimental setup of Photonic Crystal Resonator Tester at Stanford, featuring stacked aperture stages with integrated actuators controlled by NSTRUCT (courtesy of Meredith M. Lee, PhD candidate)

While the benefits of compact size and lower cost are clearly demonstrated by the CONEX-TRA, the importance of instrument control and communication handling via PC is another aspect that cannot be underestimated in creating a portable diagnostic device. The CONEX controller, used with the NSTRUCT instrument manager, provides intuitive command set and fully programmable software platform, enabling a simplified setup, easy integration and robust communication. "With NSTRUCT, I was able to start the experiment and data acquisition the same day I acquired the instruments," Meredith M. Lee says.

Newport provides a complete portfolio of products required in this application, including opto-mechanical components, spectrometers, translation stages, motorized actuators and controllers as well as NSTRUCT, Newport's free instrument control software.

For more information, please contact Newport sales and applications engineers.

1. Ofer Levi, Meredith M. Lee, Jingyu Zhang, Virginie Lousse, Steven R. J. Brueck, Shanhui Fan, James S. Harris, "Sensitivity analysis of a photonic crystal structure for index-of-refraction sensing," SPIE Vol. 6447, 64470, (2007)