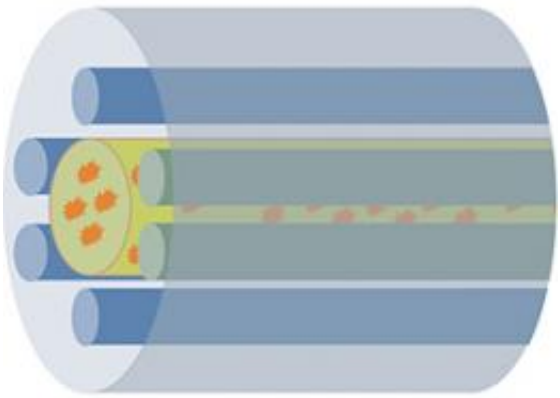
Hollow optical fibers containing light-emitting liquids hold big promises for biological sensing applications

August 2 2012



Processing biological samples on a small substrate the size of a computer chip is becoming a common task for biotechnology applications. Given the small working area, however, probing samples on the substrate with light can be difficult. To address this issue, Xia Yu and co-workers at the A*STAR Singapore Institute of Manufacturing Technology have now developed an optical fiber system that is able to deliver light to microfluidic chips with high efficiency.

“Our compact optical fibers are designed for use with high-throughput detection systems,” says Yu. “They are ideal for use in space-restrictive

locations."

A common way of probing biological samples is by light. In this method, the sample is excited by an external light source and the light emitted in response is detected, which provides a unique fingerprint of the substance. Conventional techniques are able to deliver light to samples and probe the response, but they are not very efficient at probing a small sample volume. A solution to this is to use optical fibers that are able to guide light to small spaces. The drawback with this technique, however, has been that it can be difficult to insert the external probe light into the optical fiber with sufficient efficiencies.

Yu and her co-workers have now circumvented this problem by using optical fibers with a hollow core (see image). The empty hollow core can be filled with liquids — in this case, with chemiluminescent solutions. The liquid is important to promote the transport of light through the core. In addition, these solutions consist of two liquids that when brought together initiate a chemical reaction that emits light. If such a solution is placed directly within the hollow core the problem of coupling light into the fiber is circumvented. This not only avoids external light sources but also promotes an established technology.

"The use of chemical luminescence is a common technique for a variety of detection assays in biology," says Yu. "By incorporating the emission mechanism into optical fibers, we can use it as a light source for sensing applications in microfluidics systems."

First tests for such sensing applications are already underway, although some challenges remain. For example, there might be losses in the light emitted by the fluid if the emitted light is not perfectly confined within the fiber. Such problems can be solved through improved fiber designs and an appropriate choice of materials, and applications of these fibers for microfluidic systems are promising.

More information: Yu, X. et al. Chemiluminescence detection in liquid-core microstructured optical fibers. *Sensors and Actuators B: Chemical* 160, 800–803 (2011).dx.doi.org/10.1016/j.snb.2011.08.065

Provided by Agency for Science, Technology and Research (A*STAR), Singapore