

Localized biosensing with Topas microstructured polymer optical fiber

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Microstructured Optical Fibers (MOFs) has become a driving force for development of new devices in different fields, one of which is sensing of gaseous, chemical and biological samples. Such fibers have the advantage of offering an efficient interaction though evanescent waves between the guided light and a sample positioned into the holes.

Microstructured Polymer Optical Fibers (mPOFs)¹ have recently received particular interest. The lower melting temperature of the polymer, the more flexible hole patterns obtained by drilling the preform, the easier manipulation, and improved biocompatibility are the main advantages against their silica based counterparts. The biocompatibility is the key issue for development of mPOF biosensors, because it allows the use of simple immobilization procedures.²

We fabricated mPOFs from Topas cyclic olefin copolymers (Topas COCs).³ In contrast to the most commonly used Polymethyl methacrylate (PMMA), Topas has no monomers and its moisture absorption is hundred times lower than PMMA, allowing better conditions for drawing of optical fibers.

In addition, we developed a novel concept for fiber optical biosensing based on the biochemical properties of Topas,⁴ which allows one or more *localized* sensor layers to be defined in predetermined sections of the fiber.

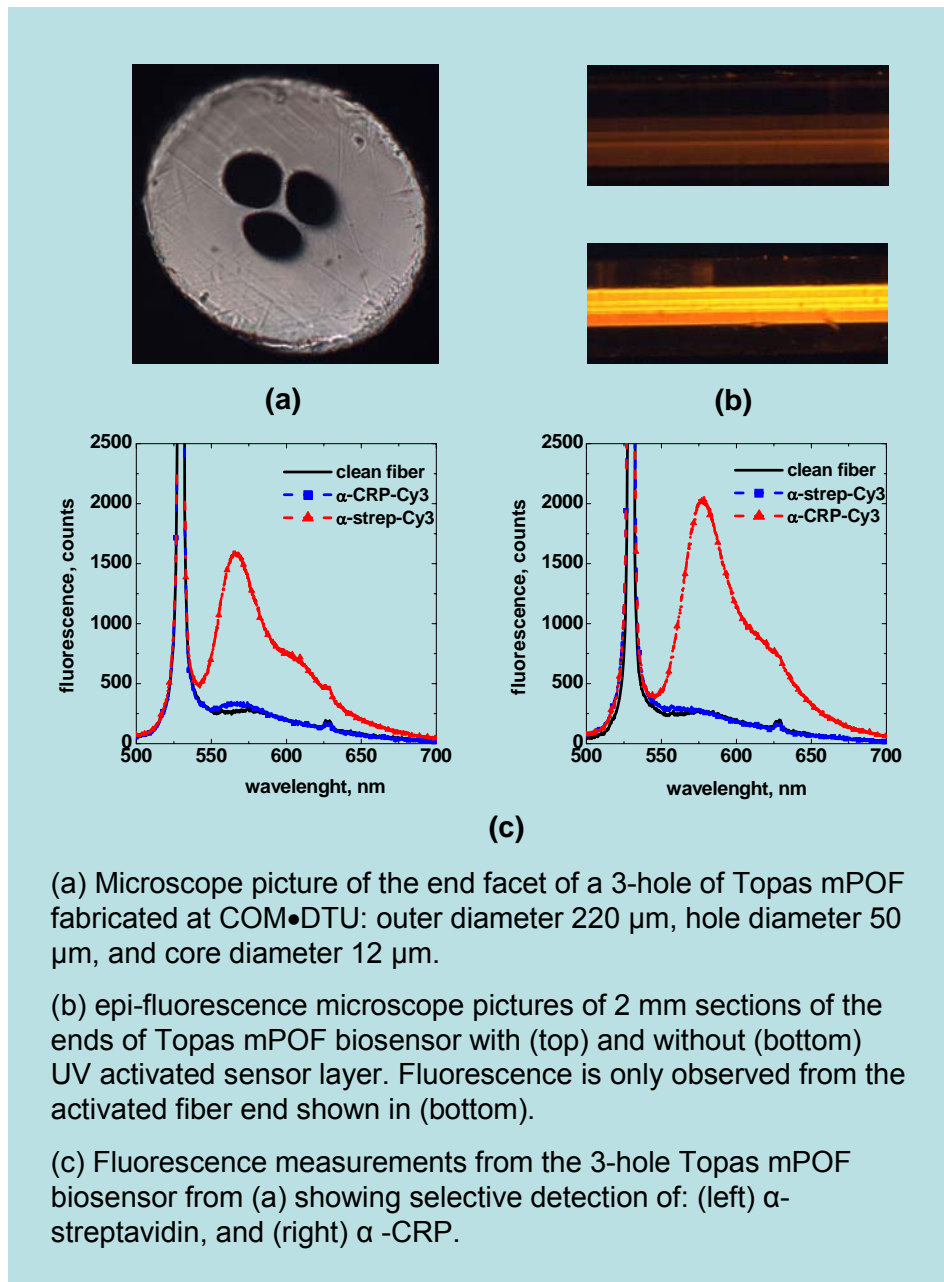
Topas is a chemically inert material and direct binding of biomolecules on its surface is difficult. However, commercially available Antraquinon (AQ) linker molecules can attach to the Topas surface when activated by UV light⁵ and can subsequently accept sensor layers. In contrast PMMA will always accept sensor layers.

A 30 cm long piece of the 3-hole mPOF shown in figure (a) was used to demonstrate the concept. The fiber was filled with AQ linker solution and after an incubation period of one hour, half of it was illuminated with a UV lamp.

In order to confirm the *localized* binding of the AQ molecules to the surface and hence the localized definition of a sensing layer in only one end of the fiber, we used a well-known antigen-antibody binding detection procedure,² where the sensing layer is build from streptavidin molecules. The biosensor was then exposed to aqueous solution of fluorophore labeled α -streptavidin. The result of the capture process was investigated under an epi-fluorescence microscope. Figure (b) top shows an image of a 2 mm section of the fiber end with UV activated sensing layer, and Fig. (b) bottom shows the other end with no UV activation. An excellent differentiation between the two parts was observed, proving that the sensor layer was only present where the AQ molecules have been activated by UV light.

Figure (c) shows that selective detection of antibodies can be achieved with such biosensor. This was demonstrated by probing fibers with different sensor layers (streptavidin and CRP) with labelled α -streptavidin and α -CRP molecules.

As a consequence of the need for UV activation in the presented concept, a UV mask can be used to define localized sensor layers inside a Topas mPOF. We believe this technique can contribute to development of multi-antibody mPOF based biosensors by definition of different sensor layers in the same fiber.



References and links

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