Applications of microstructured polymer optical fibres

M A van Eijkelenborg[1], A Argyros[1,3], A Bachmann[5], G Barton[1,2], G Henry[1], N A Issa[1,3], K F Klein[4], M C J Large[1], S Manos[1,3], W Padden[1], L Poladian[1], H Poisel[5], Y. Zhao[1]

[1] *Optical Fibre Technology Centre, Australian Photonics CRC, University of Sydney, 206 National Innovation Centre, Australian Technology Park, NSW 1430, Australia*
[2] *Department of Chemical Engineering, University of Sydney, NSW 2006, Australia*
[3] *School of Physics, University of Sydney, NSW 2006, Australia*
[4] *Fachhochschule Gießen-Friedberg, University of Applied Sciences, D 35390 Gießen, Germany*
[5] *Polymer Optical Fiber Application Centre, Wassertorstrasse 10, 90489 Nuernberg, Germany*
m.eijkelenborg@oftc.usyd.edu.au

Abstract: Microstructured polymer optical fibres have recently been developed, providing new fibre functionalities for a range of applications, including imaging, high-bandwidth transmission, sensing, astronomy, high birefringence and polymer fibre lasers.

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Microstructured polymer optical fibres (mPOFs) have been developed over the last two years, providing plastic fibres in which light guidance is achieved through the use of microstructure. Specific mPOFs that have been or are being developed for a range of applications will be presented, including the following.

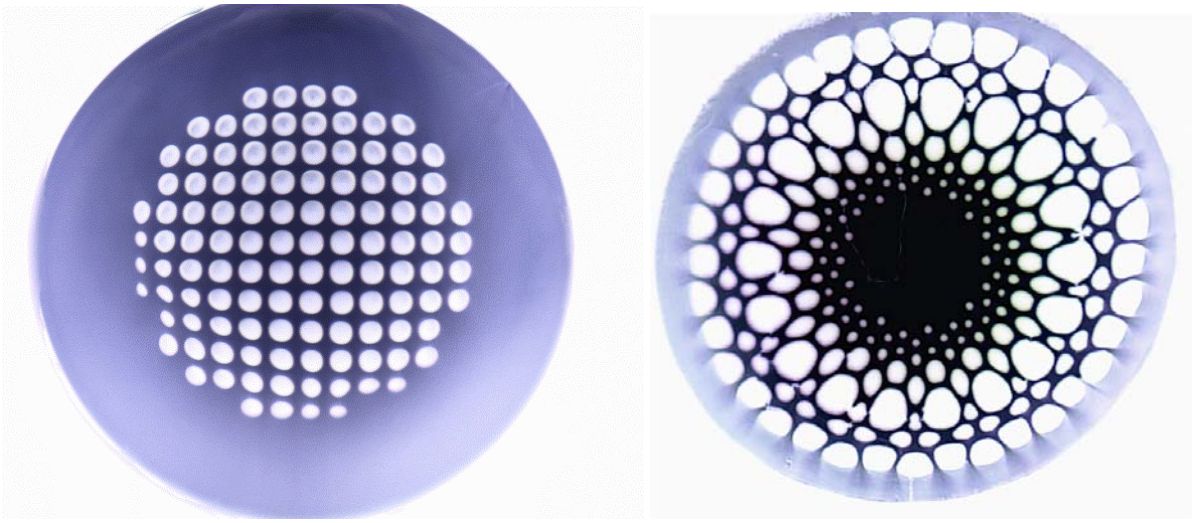

Fig. 1 Microscope image of an 800 µm diameter microstructured polymer optical fibre with 42 micron hole-to-hole spacing developed for imaging purposes (left) and a 250 µm diameter graded-index mPOF with a bandwidth of 4.2 Gbits/sec in 100 metres (right)

Imaging: The imaging operation of a 250µm diameter multicore mPOF with 112 individually guiding cores as shown in Fig. 1 is demonstrated for miniature endoscopic medical applications.

High-bandwidth transmission: A graded-index mPOF has been developed with a transmission rate of 4.2 Gbits/sec in 100m for high-bandwidth applications such as local-area-networks and fibre-to-the-premises.

Sensing: Tunable and erasable 35dB deep long-period gratings with high transverse strain sensitivity were mechanically-induced in mPOFs for applications such as variable attenuators and fibre sensors.

mPOF fibre lasers: Organic dye doped mPOFs are being explored using a new post-polymerisation doping technique. Fluorescence spectra and gain measurements of Rhodamine doped mPOF will be presented, and work is progressing towards mPOF-based lasers.

Birefringence: Asymmetric microstructured fibres are known to exhibit very strong birefringence. Using the large degree of freedom that polymer fibre fabrication allows, mPOFs in which the birefringence arises due to substantially elliptically shaped holes were fabricated and their birefringence measured.

Preform profiling: A non-destructive technique is presented to determine the two-dimensional refractive-index profile of microstructured fibre preforms. The holes are filled with index matching oil and an improved optical path-length formula and back projection method is used to reconstruct the preform refractive index distribution [2].

Small-core mPOF: A preform sleeving technique is demonstrated that has allowed the fabrication of single-mode polymer microstructured fibre with the smallest core and hole dimensions yet reported. Numerical modelling was carried out for one of the fibres produced, having a 570µm external diameter, a core diameter of 2.23µm, and average hole diameter and hole spacing of 0.53µm and 1.38µm respectively. This fibre was shown to be endlessly single-mode [3].

References

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