DESIGN, FABRICATION, AND CHARACTERIZATION OF MICROSTRUCTURED POLYMER OPTICAL FIBERS

C.-W. Huang, M.-C. Ho, H. H. Chien*, K. J. Ma*, Z. P. Zheng*, C. P. Yu, H. C. Chang, and C. C. Yang
Graduate Institute of Electro-Optical Engineering and Department of Electrical Engineering,
National Taiwan University
No. 1, Sec. 4, Roosevelt Rd., Taipei City, 106, Taiwan
Tel: 886-2-23635251x223, E-mail: mcho@ntu.edu.tw

*Department of Mechanical Engineering, Chung-Hua University
No. 707, Sec. 2, WuFu Rd., Hsinchu, 300, Taiwan
Tel: 886-3-5186448, E-mail: KJMa@chu.edu.tw

Abstract – Fabrication and characterization of microstructured polymer optical fibers (MPOFs) are presented. The effects of drawing temperature and heating time during the fabrication processes are studied. The fibers exhibit single-mode characteristics as predicted by numerical simulation.

SUMMARY

Silica-based photonic crystal fibers (PCFs) have been studied extensively since they were successfully fabricated. Compared to traditional optical fibers, PCFs have a lot of attractive features. For example, with proper air hole pattern designs, the dispersion, cut-off wavelength, numerical aperture, and nonlinear coefficients can be manipulated to certain desired values, which can not be easily achieved by traditional optical fibers. Recently, polymer-based PCFs, which are generally called microstructured optical polymer fibers (MPOFs), have been fabricated and studied. Compared to silica-based PCFs, MPOFs have advantages such as better mechanical flexibility and considerable choices of material that can be used. In addition, MPOFs can in principle be fabricated at a much lower cost and novel functionalities can possibly be explored with new materials. We have successfully fabricated MPOFs using the stack-and-draw method. Drawing temperature is the most crucial parameter in the fabrication processes. At a relatively low temperature ($<175^{\circ}\text{C}$), the ratio of air hole diameter d to the pitch Λ between the holes nearly remains the same. The diameter d is in a range between 3.5 and 4.5 μm and the pitch Λ is between 12 and 14 μm . The fraction of air present in the samples is in a range up to around 30%. Increasing the furnace temperature to over 175°C , the hole size is significantly reduced due to the effect of strong surface tension. We have also measured the mode pattern and loss of the MPOF samples. Although the loss is pretty high at $\lambda=1.55 \mu\text{m}$, we have conceptually demonstrated single-mode operation of the MPOF even though it has a large core size. Further studies are needed to confirm the single-mode operation and to understand the loss mechanism as well as other optical properties.