



Fabrication and characterization of porous-core honeycomb bandgap THz fibers

Bao, Hualong; Nielsen, Kristian; Rasmussen, Henrik K.; Jepsen, Peter Uhd; Bang, Ole

Publication date:
2013

[Link back to DTU Orbit](#)

Citation (APA):

Bao, H., Nielsen, K., Rasmussen, H. K., Jepsen, P. U., & Bang, O. (2013). *Fabrication and characterization of porous-core honeycomb bandgap THz fibers*. Abstract from International Workshop on Optical Terahertz Science and Technology (OTST 2013), Kyoto Terra, Japan.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Fabrication and characterization of porous-core honeycomb bandgap THz fibers

Hualong Bao¹, Kristian Nielsen¹, Henrik K. Rasmussen², Peter Uhd Jepsen¹, and Ole Bang¹

¹Department of Photonics Engineering, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark

²Department of Mechanical Engineering, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark

* Corresponding authors: oban@fotonik.dtu.dk, puje@fotonik.dtu.dk

We have fabricated a porous-core honeycomb fiber in the cyclic olefin copolymer (COC) Topas® by drill-draw technology [1]. A cross-sectional image of the fabricated fiber is shown in the left Panel of Fig. 1. Simulation of the electromagnetic properties of the fiber shows two wide bandgaps within the frequency range 0.1 to 2 THz, and numerous sharp resonant features are visible in the core power ratio, indicative of resonant coupling between the reflected field from the outer interface of the fiber and the core mode. The fiber is experimentally characterized with a commercial fiber-coupled THz-TDS system (Picometrix T-Ray 4000). The reference pulse before coupling into the fiber is shown in Fig. 1(a) and the time trace of the THz pulse after propagation through a 5-cm long segment of fiber is shown in Fig. 1(b) (blue curve). After adding some water on the outside of the fiber surface, the transmitted pulse experiences less pronounced oscillations at times later than 20 ps (red curve in Fig. 1(b)). Figs. 1(c) and (d) show the short-time Fourier transforms of the two time-domain traces in Fig. 1(b), overlaid with the calculated group delay in the two bandgaps (black squares). The frequencies below approximately 0.6 THz are attenuated by adding a layer of water on the outside of the fiber surface, while the transmission in the two bandgaps in the 0.7-1.1 THz and 1.3-1.7 THz regions are unaffected by the water. This observation demonstrates that the absorptive water layer effectively strips the cladding modes from the fiber. The propagation loss is measured in a cut-back experiment. The fundamental bandgap at 0.75-1.05 THz is found to have losses lower than 1.5 dB/cm, whereas the loss is below 1.0 dB/cm in the reduced bandgap 0.78-1.02 THz, as shown in Fig. 1(g).

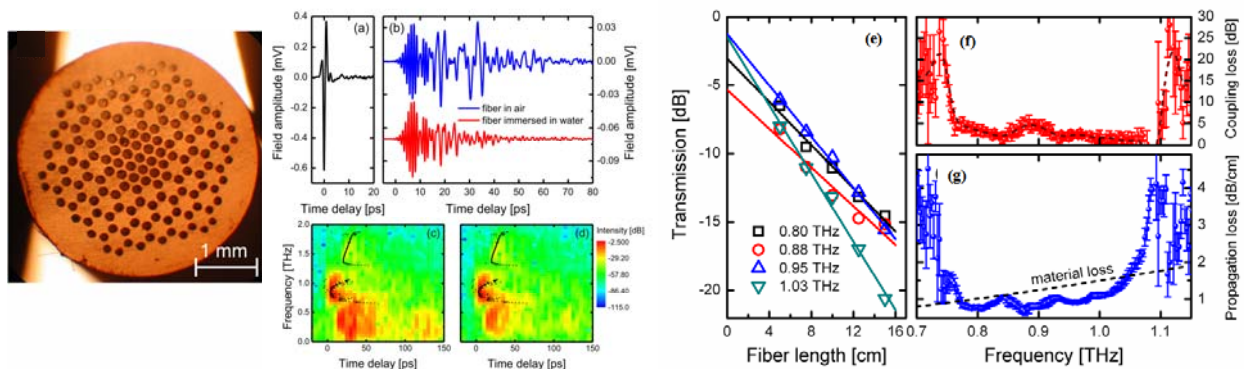


Fig. 1. (left side) Image of the end facet of the fabricated fiber. Measured (a) THz reference signal and (b) transmitted pulse through a 5 cm long honeycomb fiber with air (blue curve) and water (red curve) surrounding the outer surface. Short-time Fourier transforms of the transmitted waveforms in (b) are shown in (c) and (d), respectively, with simulated group velocity arrival times of the spectral components overlaid. (e) Relative transmission of the fiber with different lengths together with linear fits at four frequencies. Measured frequency dependent propagation loss (g) and coupling loss (f) of the fiber.

References

[1] K. Nielsen *et al.*, *Optics Express*, **17**, 8592-8601 (2009).