Microstructure and Mechanical Properties of Air Core Polymer Photonic Crystal Fibers

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Abstract

Polymer based photonic crystal fibers with low cost manufacturability, and the mechanical
and chemical flexibility offer key advantages over traditional silica based photonic crystal fibers.
PMMA photonic crystal fiber was fabricated by stacking an array of PMMA capillaries to form a
preform, and followed by fusing and drawing into fiber with a draw tower. The air hole diameter and
fraction of photonic crystal fiber can be manipulated by the thickness of PMMA capillaries and
drawing temperature. The measurement of mechanical properties was performed by universal testing
machine. The air core guiding phenomena was observed in air-core PMMA photonic crystal fiber.
The ultimate tensile strength of PMMA photonic crystal fiber increases with the increase of the
air-hole fraction. The mechanical strengths of all the microstructured optical fibers are higher than
those of traditional PMMA fibers. This can be attributed to the introduction of more cellular interfaces
which hinder the crack propagation and hence improve the mechanical strength. The plastic extension
of PMMA microstructured optical fiber decreases with the increase of the air-hole fraction. Overall,
the mechanical flexibility of PMMA microstructured optical fiber is superior than that of traditional
PMMA optical fibers.

Keyword：PMMA, air core, photonic crystal fibers, mechanical properties