Improved Gas Filling and Sealing of an HC-PCF
Compact hermetic joint is formed to seal connectorized all-fiber gas reference cell.

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An improved packaging approach has been devised for filling a hollow-core photonic-crystal fiber (HC-PCF) with a gas, sealing the HC-PCF to retain the gas, and providing for optical connections and, optionally, a plumbing fitting for changing or augmenting the gas filling. Gas-filled HC-PCFs can be many meters long and have been found to be attractive as relatively compact, lightweight, rugged alternatives to conventional gas-filled glass cells for use as molecular-resonance frequency references for stabilization of lasers in some optical-metrology, lidar, optical-communication, and other advanced applications. Prior approaches to gas filling and sealing of HC-PCFs have involved, variously, omission of any attempt to connectorize the PCF, connectorization in a vacuum chamber (an awkward and expensive process), or temporary exposure of one end of an HC-PCF to the atmosphere, potentially resulting in contamination of the gas filling. Prior approaches have also involved, variously, fusion splicing of HC-PCFs with other optical fibers or other termination techniques that give rise to Fresnel reflections of about 4 percent, which results in output intensity noise.

In the improved approach (see figure), at first, one end of an HC-PCF is mechanically spliced to one end of an index-guiding optical fiber, the end face of which has been cleaved at an angle to suppress Fresnel reflections. The fibers are placed in a V-cross-section groove in a piece of silicon with a gap of 30 to 100 μm between their end faces. The fibers are fixed in place in the groove by use of a low-shrinkage epoxy. This keeps the polymer from becoming rough, porous, or poorly bonded.

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Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18246-1.