TLB
Technologie-Lizenz-Büro
der Baden-Württembergischen
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Simple splicing and reduced coupling losses when joining optical solid- and hollow-core fibers

Background

Optical fibers (fiber optic cables) are particularly well suited for long-distance data transmission, as the attenuation losses are significantly lower than e.g. when using copper conductors. However, keeping attenuation values low also means keeping coupling losses due to splicing of the fibers as low as possible, i.e. the fiber ends must be precisely (sub-µm range) aligned and fitted together without deformation.

The splicing technique of the invention provides a simple, adaptable method to combine solid- and hollow-core fibers of different thickness. It can also be used to connect heat-sensitive fibers, since the permanent connection of the fibers is carried out without fusing.

Problem

Until now, splicing equipment has been used to join the ends of fibers by fusing fiber ends through arcs or glowing spirals and thus adhering them to one another. The solid-core optical fiber is chamfered, so that a gap is created, which allows for subsequent filling of the hollow-core fiber. However, the reproducibility of a splice with gap is limited. If the internal structure or the filling of the hollow-core fiber are heat-sensitive, it is nearly impossible to fit them to each other without deformation.

Alternative approaches to connect the fibers via a sleeve have the disadvantage that the fibers to be joined must have an exactly matching diameter and air is often trapped between them. This may lead to bubble formation in the previously filled hollow-core fiber and hence to increased coupling losses.

Solution

Scientists at the University of Stuttgart have now developed a simple and flexible method of joining solid- and hollow-core fibers that can be used to combine fibers of different diameters permanently with low-loss and without the application of heat.

The connection technique exploits the new possibilities opened up by 3D printing processes. A sleeve is printed on the end of the solid-core optical fiber and the inner diameter of the sleeve is adapted to the thickness of the connected hollow- or solid-core fiber. The inner annular surface of the sleeve can be slightly tapered to facilitate insertion of the fiber. Air entrapment is prevented by vents engraved into the ring. Subsequently, the connection may be stabilized by an adhesion point which surrounds the sleeve.

Material and design of the sleeve are flexibly adapted to the fibers to be connected.

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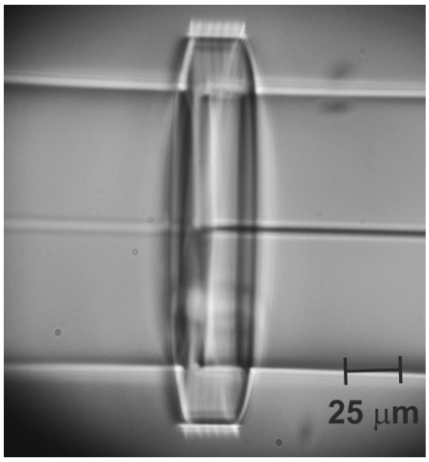
Development Status
Prototype / TRL5

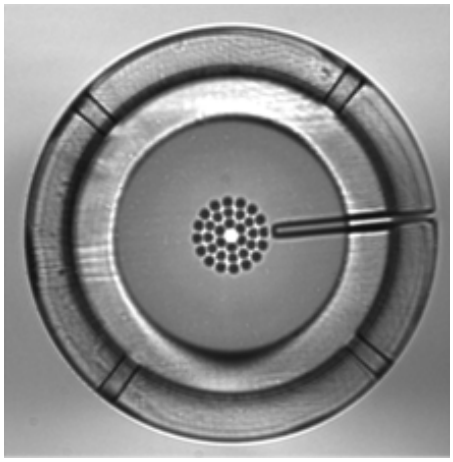
Patent Situation
DE 102015003652 B4 granted
US 9,804,336 B2 granted

Reference ID
14/092TLB

Service
Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology and assists companies in obtaining licenses.



Micrograph of joined fibers. (Photograph: University of Stuttgart)



View of the 3D-printed sleeve. (Photograph: University of Stuttgart)

Advantages

- Durable, stable and simple connection of optical solid- and hollow-core fibers
- High accuracy and reproducibility
- Gentle method without the application of heat, suitable for joining heat-sensitive fibers
- Joining of fibers of various types and different diameters
- Reduction of coupling losses at the interface through planar joint of solid- and hollow-core fibers
- Hollow-core fibers may also be subsequently filled

Application

Splicing of optical fibers