Optical fiber port with nanometer positioning precision for rapid prototyping of semiconductor photonic devices

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Optical fibers are widely used as a link connecting various types of precise micro-scale devices (e.g. sensors [1], laser chips [2], microfluidic systems [3], integrated photonic circuits [4], etc.) with the macro-sized world. However, small size of optical fibers requires positioning with sub-micrometer precision to couple light into/from the region of interest. Such accurate positioning is very challenging, especially in the early phase of the device testing when precision is as important as simplicity and rapid fabrication. Currently the most common methods of integrating optical fibers with devices under test are based on V-grooves or cross-hatched grooves [5-7]. Such solutions involve complex procedures with many fabrication devices and incorporate invasive techniques like etching, cutting or drilling which cannot be easily used for fragile structures.

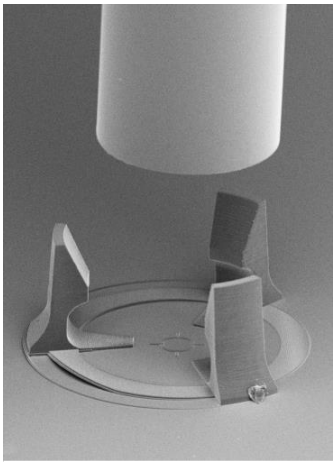

Fig. 1 SEM image of the DLW 3D-printed optical fiber micro-connector.

In this paper we present an optical fiber port (Fig. 1) fabricated by 3D Direct Laser Writing (DLW) - a non-invasive, fast and reliable method. After introducing the design of fiber micro-connector which allows for quick and precise docking, we provide statistical analysis of a single mode fiber positioning accuracy. Durability tests with rapid thermal cycling down to liquid helium temperature were also performed on optical fiber attached to CdTe/ZnTe quantum well.

All these benefits as well as compatibility of direct laser writing on a wide range of substrates including glasses, plastics, metals and broad range of semiconductors enables incorporating the optical fiber port into many areas of research.

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