Abstract—An ultraviolet (UV)-excimer-laser-based cleaving procedure for silica fiber has been developed that opens possibilities towards automated cleaving for high-volume production of fiber-optic assemblies. A selective ablation of the glass in the form of a small rectangular cavity serves as a fracture initiator when the fiber is put under stress. The position of the UV-excimer-laser-induced scratch is very precise. The system provides high-quality cleaves on single-fiber and ribbon configurations. The end angle of the cleaved optical fiber is measured using a noncontact optical interferometer system. Insertion loss after splicing is in the range of 0.03 dB, which is compatible with mechanical-cleaved fibers.

Excimer laser ablation of glass fibers

It is observed that the circular geometry of the fiber acts as a lens for the laser beam and focuses the incident light somewhere underneath the fiber. As a result, the laser spot size is highly concentrated on the lower fiber surface and the threshold ablation intensity of the fiber is reached, for a relatively low fluence of the incident laser beam. This initiates the ablation of a small cavity with rectangular shape.

Design of the fiber holder

"score-and-bend" technique

Stress introduced by stretching the fiber over an anvil is tensile on the outside bend of the fiber and zero on the inside bend of the fiber.

Experimental results

The end angle of the cleaved optical fiber is measured using a non-contact optical interferometer system (Norland ACCIS NC-3000). The latter operates in the red light mode (λ=660 nm) exploiting phase shift interferometry to map the surface of the cleaved facet. The cleave angle is calculated by finding the best fit plane inside the region, where the interference fringes are apparent. The shape and distribution of the fringes also provide valuable data on the topography of the fiber end facet.

Laser cleaving of embedded fibers

Test sample (fabricated and made available by FZK, Karlsruhe) used in the framework of NEMO-WP9 to test laser-cleavage of embedded optical fibers.

<table>
<thead>
<tr>
<th>angle</th>
<th>average</th>
<th>standard deviation</th>
<th>fusion splicing losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser cleave</td>
<td>1.06°</td>
<td>0.47°</td>
<td>0 - 0.05 dB</td>
</tr>
<tr>
<td>Mechanical cleave</td>
<td>1.01°</td>
<td>0.61°</td>
<td>0 - 0.03 dB</td>
</tr>
</tbody>
</table>

This work was partially supported by the IWT (Institute for the Promotion of Innovation by Science and Technology, Flanders, Belgium) and by Tyco Electronics (Kessel-Lo, Belgium) through the LIAM-project (High-performance, Low-cost Interconnection Components for a new Generation of Access Network Products, Manufactured using new Micro-Optical Fabrication Technologies) and is part of the NEMO-WP4 & WP9-joined research activities.