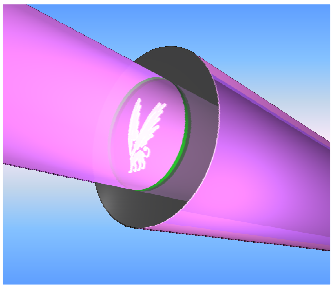
ALIGN-AND-SHINE PHOTOLITHOGRAPHY

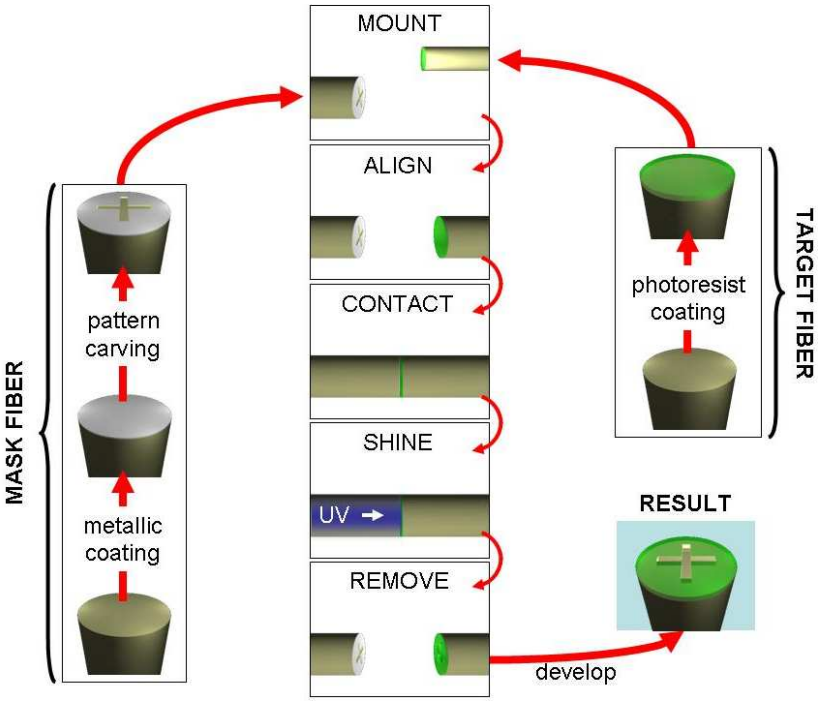
a new technique to transfer arbitrary patterns on optical fibers



The possibility to shape the cleaved end of an optical fiber in the form of miniaturized structures represents a fascinating opportunity for the development of devices for photonics, optical trapping, biochemical sensing, atomic force microscopy, et cetera. At present, however, there are no techniques for batch micromachining on optical fibers. As a first step in the way to solve this problem, we have invented a process that allows series production of arbitrary patterns on a photoresist layer deposited on the cleaved end of an optical fiber: the *align-and-shine* photolithography technique.

Optical lithography is the most widespread micromachining processes in silicon-based technologies. The application of this process for fabrication of patterns on optical fibers requires a precise alignment of the lithography mask to the fiber, which is a too cumbersome operation if standard aligners are to be used. On the other hand, over the last decades, the need of easy-to-use and reliable optical fiber fusion splicing machines, triggered by the fast growth of the telecommunication industry, has pushed enormous progress in the development of image-based active alignment techniques that align and bring to contact the cleaved ends of two opposite optical fibers automatically within a few seconds. The align-and-shine photolithography technique is based on the idea to combine standard optical lithography with the opto-mechanical tools developed for optical fiber fusion splicing.

In the figure on the right we present a schematic drawing of the steps on which our technique is based. The shadow mask is directly fabricated on the facet of a UV multimode fiber (the mask fiber), which is aligned with another fiber, previously coated with photoresist (the target fiber). The two fibers are then aligned and brought to contact on a splicing machine. Light coupled from the opposite end of the mask fiber transfers the pattern to the photoresist layer, which can then be developed according to standard techniques. The pattern written on the mask can thus be transferred to a large number of other fibers in a sequence of steps that adapt well to series production.



The *align-and-shine* photolithography technique represents an unprecedented opportunity for the development of scientific and technological tools based on the possibility to suitably engineer the facet of an optical fiber. Our goal is to establish links with industrial partners and venture capitalists and study with them possible implementations of commercial products.[1]

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