Advanced fiber gratings micro-fabricated with the femtosecond laser

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The femtosecond laser (fs), owing to its unique characteristics of ultrashort pulse duration and high peak power, enables the modification of a wide range of dielectric materials that are transparent at the laser's operating wavelength. We have employed femtosecond laser technology to fabricate various types of fiber gratings and have developed advanced inscription techniques across different optical fibers for diverse applications. In this report, we present two recent advancements in this area:

1) Engineering the Inscribing Laser Beam to Reduce Insertion Loss

Fiber gratings fabricated using conventional femtosecond laser inscription methods, such as the line-by-line technique, often suffer from high insertion loss [1]. We introduce an advanced fabrication approach that involves engineering the shape of the laser focus. By reshaping the focal volume, we can inscribe grating planes within the fiber core, resulting in a significant reduction in insertion loss.

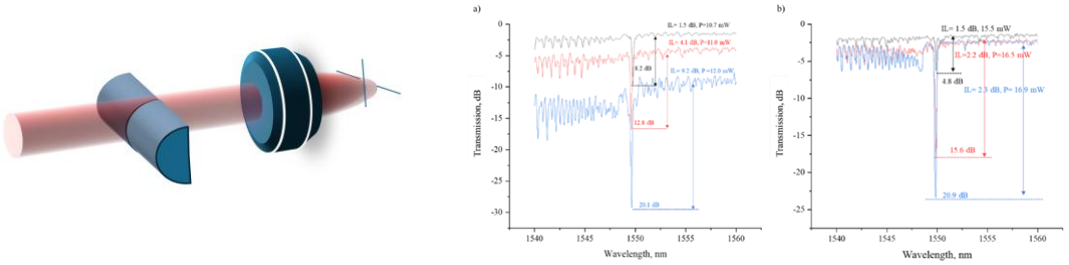

Figure 1 Beam shaping with a cylindrical lens

2) Long-Period Gratings (LPGs) in Few-Mode Optical Fibers

Mode conversion is a critical function for spatial mode division multiplexing in high-capacity optical communication systems. Vortex modes, in particular, can carry orbital angular momentum (OAM), offering an additional degree of freedom for manipulating the spatial properties of light. Here, we summarize our work on LPGs inscribed at various positions within few-mode fibers to achieve mode conversion[2]. These devices facilitate the flexible generation of multi-channel, multi-order OAM modes, paving the way for advanced spatial multiplexing schemes.

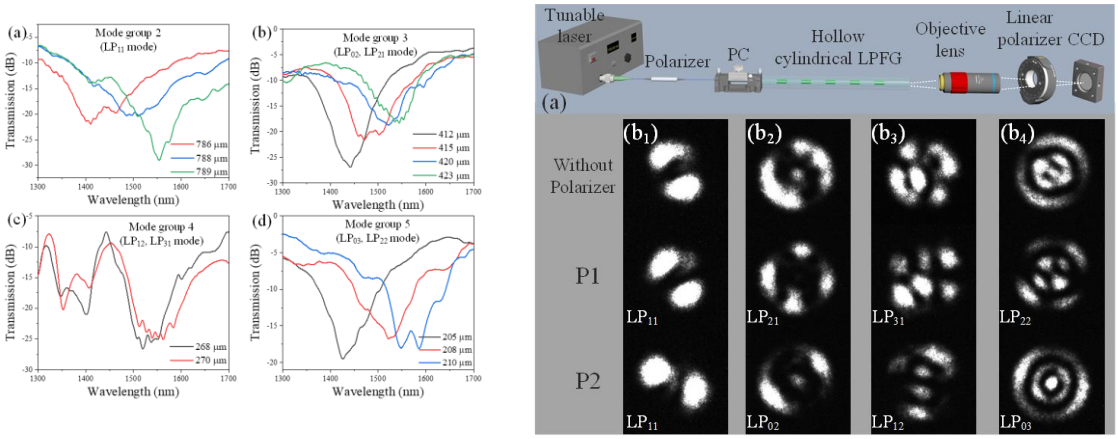

Figure 2 OAM generation by mode conversion of LPGs fs-inscribed in an few mode optical fibre

REFERENCES

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