TWISTED MICROSTRUCTURED OPTICAL FIBERS

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Twisted optical fibers exhibit several unusual properties related to their helical symmetry and therefore provide new opportunities for light controlling and manipulation. Most of their known applications are related to coupling between core and cladding modes, which can be used for development of sensors, filters, dispersion controllers, circular polarizers, couplers and optical vortices generators.

We present results of rigorous numerical simulations based on the transformation optics formalism, which provide better understanding of the effect of coupling between core and cladding modes in twisted microstructured fibers (MOFs) and shows previously disregarded limitations and capabilities of such structures.

In particular, we prove that the explanation of the effect of coupling between core and cladding modes in twisted microstructured fibers (MOFs) proposed in Science paper (G. K. L. Wong, M. S. Kang, H. W. Lee, F. Biancalana, C. Conti, T. Weiss, and P. S. J. Russell, Science 337, 446-449 (2012)) is incorrect as it wrongly assigns orbital angular momenta to the coupled cladding modes. In contrast, we demonstrate that the selection rules for orbital and spin angular momenta of coupled modes, proposed first for twisted conventional fibers, have universal character and correctly identify the coupled cladding modes in helical MOFs. Moreover, we show that in twisted MOFs the coupling between the core and cladding modes can be obtained for helix pitch much greater than previously considered, thus allowing for fabrication of coupling based devices using a less demanding method involving preform spinning.