Nanoimprint Lithography On Very Small Substrate: Fabrication Of Diffractive Optical Element On A Facet Of Single-Mode Optical Fiber

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Micro- and nanopatterned surfaces possess many optical properties that can be used when constructing optical systems. Such surfaces can be polarizing, reflection reducing, diffracting, focusing ect. One of the key optical components is the optical fiber. Ability to fabricate patterned surface on a facet of optical fiber adds additional functionality to optical fiber without compromising simplicity and compactness of optical system.

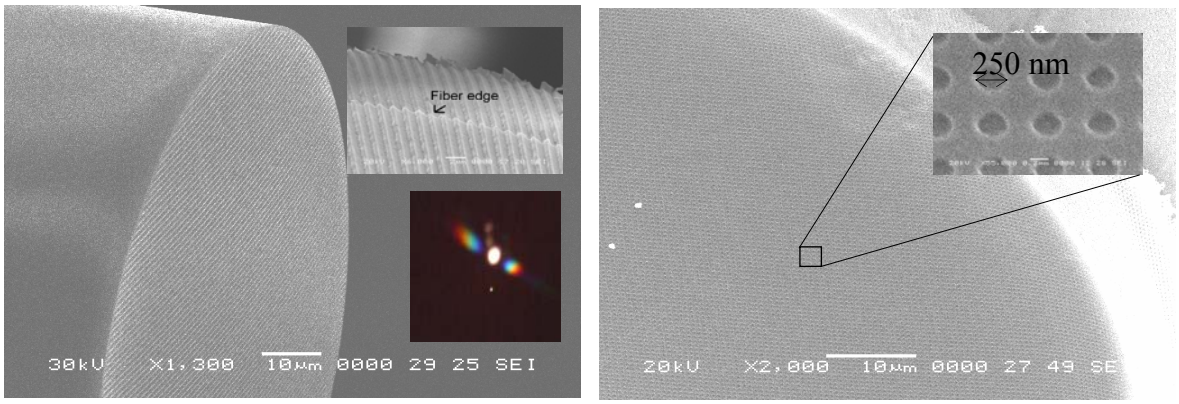
This work concentrates on development of novel method to fabricate micro- and nanoscopic patterns on a facet of optical fiber. Method is based on nanoimprint lithography (NIL), replication technique which is cost effective and suitable for producing patterns from sub wavelength dimensions to tens of micrometers. Using NIL we have fabricated blazed transmission grating (period 830 lines / mm) and demonstrative pattern reaching 250 nm line width on facet of optical fiber that has 125 µm diameter. In contrast to commercially available lensed fibers, novel fabrication method allows production of patterns and shapes unavailable with conventional fabrication methods [1]. Compared to previously demonstrated nanopatterning methods of optical fiber terminations our imprint lithography method promises relaxed design freedom and low cost of fabrication [2-4].

Our presentation describes details of our fabrication process, reports results from replication accuracy and diffraction efficiency of patterns and discusses about applications and future challenges for patterned fibers.

References:

[1] K. Shiraishi et al, J. Lightw. Technol., **15** (1997) pp. 356 - 363
[2] F. Schiappellil et al, Int. Microprocesses and Nanotechnol. Conf., Tokyo, 2003, pp. 166-7
[3] G. Giannini et al, in Proc. MICRO tec.2000.-VDE World Microtechnologies Congress, Berlin, 2000, pp. 695-7 vol. 2
[4] E. G. Johnson et al, Appl. Opt. **42** (2003), pp. 785-791

Figures:



Left figure: Blazed grating fabricated on the termination of optical fiber. Small picture on the upper left corner is close up from the edge of the fiber and the small picture on lower right corner shows the output of the fiber when white light is launched into fiber. Right figure: Array of 250 nm wide holes imprinted on the facet of the optical fiber.