Flexible trans-jacket inscription of fiber Bragg gratings for directional distributed sensing

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Abstract

An array of 18 FBGs spectrally distributed over 70 nm was written in a polyimide-coated fiber, with a single uniform phase-mask, by applying strain on the fiber prior to exposition. This flexible method will be used to develop directional sensor for distributed sensing based on a hybrid glass-polymer multicore fiber.

I. INTRODUCTION

Fiber Bragg gratings (FBGs) are good candidate for remote sensing because of their small size, their resistance to harsh environment and their eases to be distributed over long distances. The phase-mask writing technique generally lacks flexibility as it needs a different phase-mask for each Bragg wavelength. However, it was shown recently that writing FBGs through the coating of standard fibers with femtosecond laser does not degrade their mechanical integrity [1], thus allowing the possibility to apply strain prior to exposition in order to down-shift the Bragg wavelength [2]. In this communication, we report a down-shift of 70 nm at a strain of 5.5% with this technique, thus opening new possibilities for distributed sensing.

II. EXPERIMENT AND DISCUSSION

The writing setup is the same as in [2]. It is based on a Ti:Sapphire regenerative amplifier (Coherent, Astrella) with a repetition rate of 1 kHz and a central wavelength of 806 nm. The output Gaussian beam of 11 mm at $1/e^2$ is reshaped to an elliptical beam of 0.5 mm x 11 mm by a slit. The beam is then focalised through a phase-mask (Λ = 1083 nm) in the core of the fiber by a short focal length (f = 8 mm) acylindrical lens, which is mounted on two piezoelectric actuators that scanned the focalised beam over the entire core. To control the length of the grating, the beam is scanned along the fiber axis with a linear air bearing stage over a controlled length.

The fiber used in this experiment is a polyimide-coated fiber (Fibercore, SM1500(9/125)P) and it is held in place by two clamps (PhotoNova Inc., FiberVice™), one of which is mounted on a translation stage with a micrometric screw. A first FBG is written with the same parameters as in [2]. Then, the fiber is strain by an amount that is chosen to give a certain spacing between each Bragg wavelength. In this case, the steps are approximately 0.32% of strain to give a spacing of 4.1 nm between each FBG. With this method, a dense array of 18 FBGs spectrally distributed over 70 nm is made, limited by the fiber clamps capability. The resulting spectrum is shown in Figure 1.

Also, preliminary results on a microstructured polymer fiber incorporating three arrays of FBGs written using this method, prior to drawing, will be discussed. The potential of such hybrid glass-polymer multicore fiber for directional distributed sensing will be presented [3].

III. CONCLUSION

We have written an array of 18 FBGs distributed over 70 nm with a single uniform phase-mask, by straining the fiber prior to exposition. This method will be used to developed directional sensor for distributed sensing.

IV. REFERENCES

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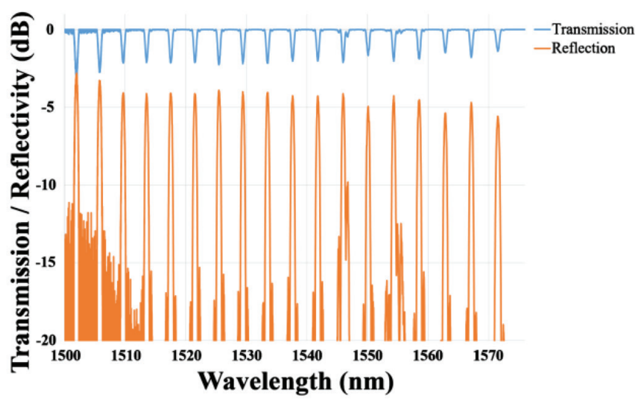

Figure 1 An array of 18 FBGs distributed over 70 nm is written with a single uniform phase-mask