Section II MEDICAL PHYSICS
Секція МЕДИЧНА ФІЗИКА

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FABRICATION OF CROSS BRAGG GRATING IN BIOMEDICAL INVESTIGATION

Abstract: In this article, an experiment was made to manufacture oblique Bragg gratings with an inclination angle of 30, 50, 70, measurements were made of the effect of temperature changes on their spectral characteristics. For this purpose, a measuring system has been developed.
Keywords: oblique Bragg grating, diffraction interference, single-mode optical fiber.

Introduction. Cross grating was made in excimer laser system Coherent Bragg Star M. In the utilized system the laser beam with 248 nm length is directed by set of mirrors fell on cylinder lens. The optical fiber was placed in the focus of lens. Phase mask was placed right before optical fiber guide. In such a way behind the phase mask, the spatial interference field with period depending on utilized phase mask was created. For creation of Bragg grating the phase mask with period of 1080 nm was utilized.

Technology. Difractional interference +/– of the first order was used for registration of Bragg's structure [2]. The photo of System for recording of fiber optic Bragg's grating is shown at Fig. 1., where: *1* – Excimer laser of Coherent Bragg Star M; *2* – Laser beam transfer system; *3* – Phase mask; *4* – Optical fiber; *5* – Superluminiscent diode; *6* – Optical spectrum analyzer.

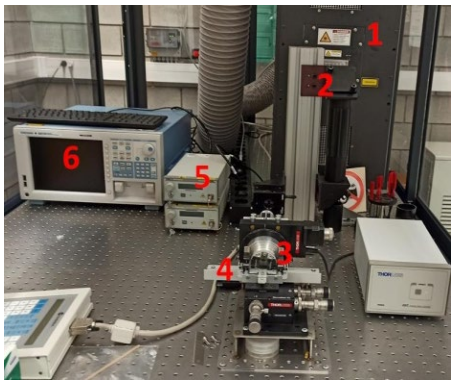


Fig. 1. System for recording of fiber optic Bragg's grating

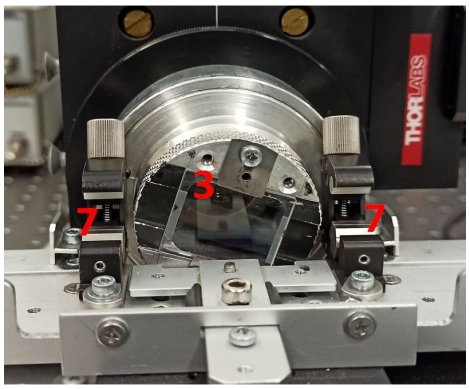


Fig. 2. System for recording of fiber optic periodical structures

Single mode optical fiber Corning SMF28 Ultra, that was a subject to earlier process of hydriding, had been used for recording of Bragg's grating. The process of hydriding was carried out for sencibilization of optic fiber to the recording of Bragg's grating process. Hydriding consisted in placing of optic fiber into hydrogen ambient under the pressure 150 bars for 7 days.

In the process of Bragg's grating recording the optical fiber was placed in holders and was exposed to laser light with changing of distribution by phase mask. Thereby, the periodic circuit is registered in optical fiber core, that corresponds to the period of interference field created behind the phase mask [2].

At Fig. 2 the photo of Bragg's grating recording with phase mask (3) and holders for fixing of fiber optic (7) is provided. The recording process was monitored by measuring of created structure spectrum by means of superluminiscent diode (5) and optical spectrum analyzer (6).

For the purpose to create the structure of TFBG of cross grating, it is required to create an angle between phase mask and created by it interference field and optical fiber axis. At Fig. 3 the system diagram is shown, in which optical fiber (1), placed in the holders (2), creates the angle (4) with lines of interference field (3), which is also the angle of slop of cross Bragg's grating structure [1].

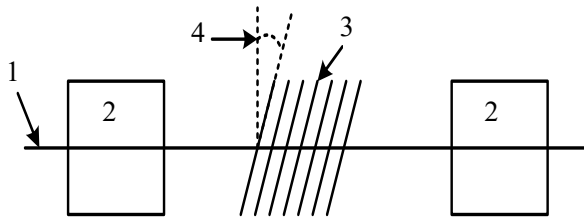


Fig. 3. System diagram recording of fiber optic cross Bragg's grating

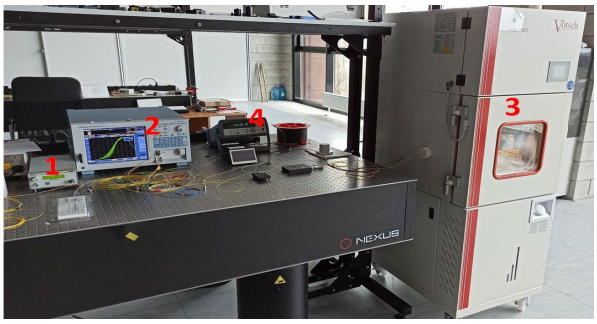
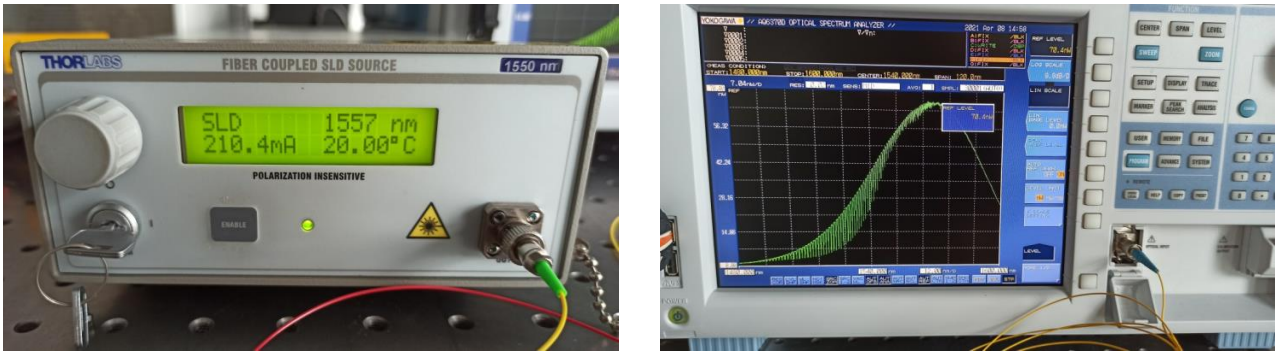


Fig. 4. System for measurement of the temperature impact on spectral characteristics of cross Bragg's grating

For fabrication of cross Bragg's grating with angle of slop 30, 50, 70, the impact of temperature changes on their spectral characteristics was measured. For that reason, the measurement system, provided at Fig. 4, is compiled.



a *b*

Fig. 5. System elements for measurement of spectrum characteristics of cross Bragg's grating: light source (*a*), spectrum analyser (*b*)

The measurement system, photo at Fig. 4, consists of: broad-band source in the shape of diode SLD (1), provided at Fig. 5, *a*, and optical spectrum analyser (2) at the Fig. 5, *b* the photo of spectrum analyser with registered spectrum of cross gratinf is shown.

Fig. 6. General view of climate chamber of Vötsch brand

Fig. 7. Bragg's grating placed in climate chamber

Bragg's grating was placed in climate chamber (Fig. 4 and 5), which gave the possibility to measure the temperature in the range from –40 to 180 of Celcius degree.

At Fig. 6 the climate chamber of Vötsch brand is shown and its parameters are in the Table 1.

Table 1

The parameters of climate chamber

№	Title of parameter/characteristics	Parameter value
1	Design voltage	230 V (+6 / –10%) 50 Hz
2	Temperature range, °C	from –40 to +180
3	Limit of absolut temperature measurement error	± 0,2°

At the picture 6 there is a photo of climate chamber with placed inside fiber optic, on which the cross Bragg's grating is recorded (Fig. 7).

Conclusion. The measurement was carried out at unit with climate chamber, which allowed to carry out the temperature change and transmit spectrum registation by means of spectrum analyser [3].

References

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