Investigation of a linear variable optical filter (LVOF) manufacturing process

S.A. Fomchenkov[1,2], A.P. Porfirev[2]

[1]Image Processing Systems Institute of RAS - Branch of the FSRC "Crystallography and Photonics" RAS, Molodogvardejskaya street 151, Samara, Russia, 443001
[2]Samara National Research University, Moskovskoe Shosse 34A, Samara, Russia, 443086

Abstract. This paper reports on fabrication process for Linear Variable Optical Filters (LVOF). This LVOF can be fabricated in a resist layer by just one lithography step. The profile of resist structure is subsequently transferred into quartz substrate by plasma etching. Complete LVOF fabrication involves deposition of a lower dielectric mirror using a stack of dielectrics on the substrate, tapered layer formation and deposition of the top dielectric mirror [1]. Shown possibility of LVOF using in experimental hyperspectral setups.

1. Introduction

Micro-cavity filter or all dielectric Fabry –Perot filter is a special class of interference filters. If optical thickness of a cavity layer that surrounded by two symmetric Distributed Bragg Reflectors (DBR) is integer multiples of λ/2 then this structure is named a micro-cavity filter

Distributed Bragg Reflector (DBR) or dielectric mirror is periodic repetition of two layers with different refractive indexes (n-high, n-low) and different thicknesses (d-high, d-low) as n × d (high) = n × d (low) = λ/4 is established for each layer.

Micro-cavity filters are used as steady filters [2], adjustable filters [3],[4] and chemical detectors [5]. Dielectric optical filters with Fabry – Perot structures are used in telecommunication, lasers and spectrometers in order to control and measure the exact wavelength range of visible and non-visible spectrum [6-8]. In a spectrometer, the optical filter with Fabry – Perot style is used to detect the wavelengths that are very close together [9]. The linear variable optical filter (LVOF) is a multi-layer Fabry-perot filter that the shape of its cavity is conical. The feasibility study of a linear variable optical filter has been carried out in a wide range (400 nm to 1000 nm) and a narrow range (from 610 nm to 680 nm and from 722 nm to 880 nm) [10-12].

This paper reports on the investigation of multi steps optical filter (MSOF) fabrication process. MSOF is handy tools for any optical experiment where filters are required [13]. The filter's wavelength can be moved in filter’s wavelength range. Filter is especially useful for spectrally shaping the excitation energy from broadband sources used for fluorescence.

2. Manufacturing process

This MSOF can be fabricated in a resist layer by just one lithography process. The profile of resist structure is subsequently transferred into defective layer of optical filer by plasma etching. Complete MSOF fabrication involves deposition of a lower dielectric mirror using a stack of dielectrics on the substrate, tapered layer formation and deposition of the top dielectric mirror. Manufacturing process shown on figure 1.

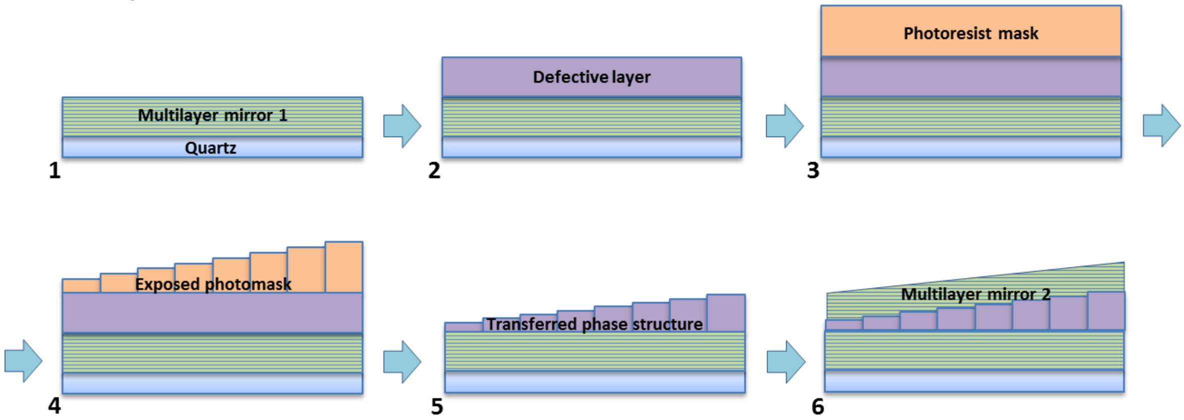

Figure 1. Multi steps optical filter manufacturing process.

On first step we deposit multilayer mirror on quartz substrate. On second step we deposit defective layer. It is material which has higher refractive index from two materials of multilayers structure. Next we coat surface by special photoresist mask. Next we make direct writing of phase structure in resist layer with help of circular laser writing station and remove of unexposed parts. Then with help of plasma etching system we transfer phase mask from resist layer to defective layer of filter. And on last step we deposit top mirror.

3. Conclusion

The main advantage of MSOF over linear variable filters is that it can be made on a small surface area. This advantage allows the use of a similar filter in optical circuits, where space and mass are important, for example for portable hyper spectrometers [14]. In this type of linear filter, by decreasing the thickness of the cavity layer, the central wavelength of the transmitted spectrum is shifted towards lower wavelengths but the band width (FWHM) does not remain constant and partly increases.

4. References

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Acknowledgments
This work was financially supported by Russian Foundation for Basic Research grant No. 18-07-01122, 18-07-01380 677 in part of design and experimental investigation of multilayer diffractive optical elements and by Russian Federation Presidential grant for support of the leading scientific schools (NSh-6307.2018.8) in part of manufacturing of diffractive optical elements.