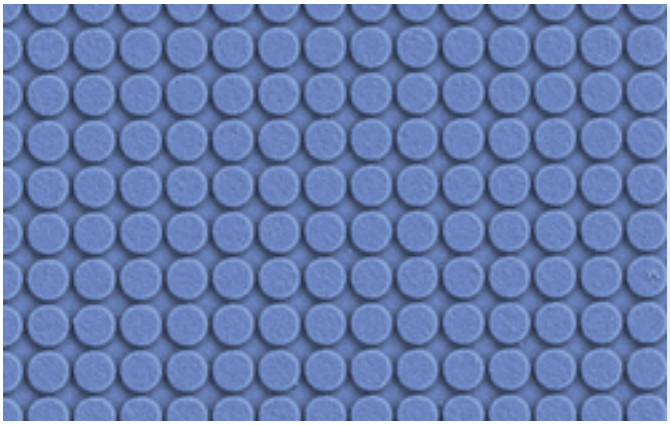
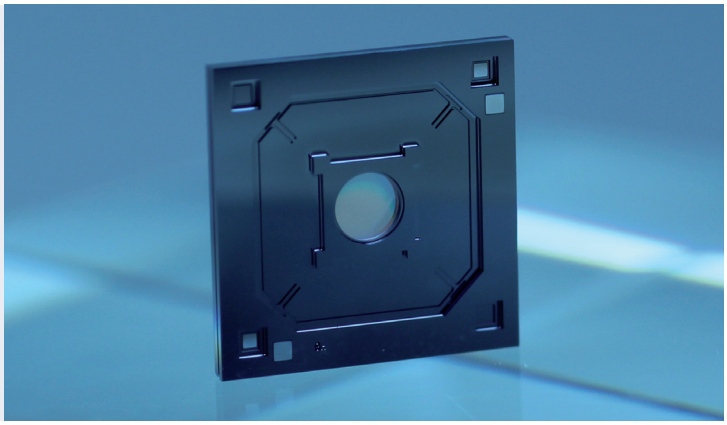
NANOSTRUCTURED REFLECTORS FOR TUNABLE BAND-PASS FILTERS





Contact

Fraunhofer ENAS
Fraunhofer Institute for Electronic Nano Systems
Technologie-Campus 3
09126 Chemnitz
Germany

Contact person
Prof. Dr. Thomas Otto
Phone: +49 371 45001-231
E-mail: thomas.otto@enas.fraunhofer.de

Dr. Steffen Kurth
Phone: +49 371 45001-255
E-mail: steffen.kurth@enas.fraunhofer.de

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Description

A novel tunable infrared filter with sub-wavelength gratings, which substitute the distributed Bragg reflectors (DBRs) in a former tunable Fabry-Perot (FP) filter, was developed. The FP resonator consists of a pair of parallel reflectors and of an air gap in between. Uniformly arranged disc resonators made of 100 nm thick aluminum at a 200 nm Si_3N_4 membrane carrier that stands freely after fabrication are building the reflector. Finite difference time domain (FDTD) analysis was applied for optimization of the dimensions of the subwavelength structures.

The samples have an aperture of 2 mm. They are tuned mechanically by electro-static forces with tuning voltages of up to 80 V and show the typical characteristics of FP filters with high peak transmittance.

The fabrication of these structures needs less effort in comparison to distributed Bragg reflectors. Since only two thin layers are used for the reflector in comparison to multiple layers of higher thickness in case of DBR reflectors, less mechanical stress is introduced into the device. The planarity is enhanced and the roughness of the reflectors is reduced as a result. It opens the way towards tunable filters having large apertures with diameters of up to 10 mm.

Applications

- Hyperspectral imaging
- Infrared spectral analysis
- Determination of concentration of substances

Fraunhofer ENAS
ZfM Zentrum für Mikrotechnologien
TECHNISCHE UNIVERSITÄT CHEMNITZ
InfraTec

Specifications

Description	Value	Unit
Free spectral range	3.0 .... 3.7	µm
Selectivity (FWHM)	100	nm
Transmittance	57 ... 90	%
Contrast	50:1 ... 100:1	

Tab. 1: Specifications of a FP filter with nanostructured reflectors.

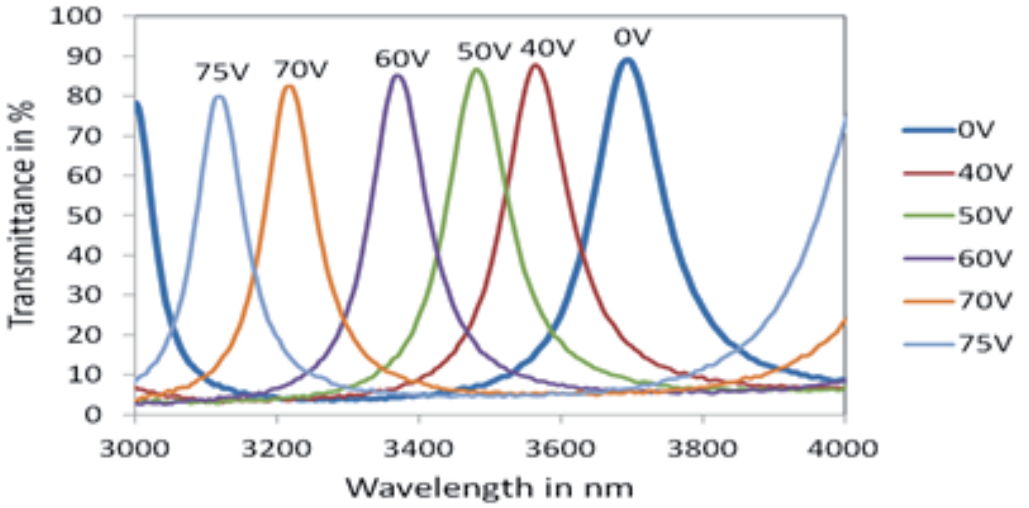
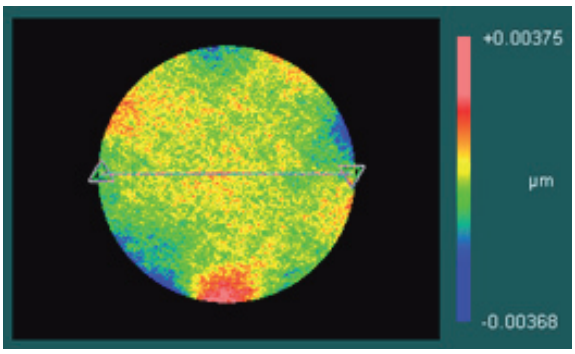
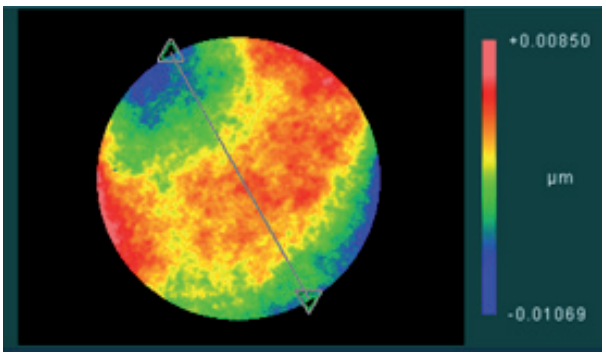


Fig. 1: Transmittance spectra of the FP filter at different control voltages.



a) Warping < 7 nm; Roughness R_a < 0.44 nm



b) Warping: < 20 nm; Roughness R_a < 3 nm

Fig. 2: Surface profile of a reflector with nanostructured surface (a) and of a DBR reflector (b).