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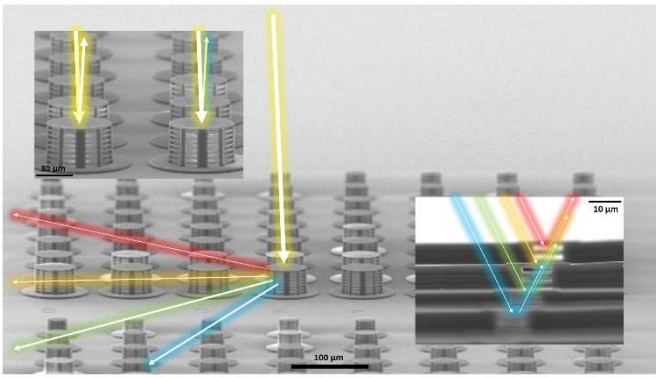
Modulable polymerbased Bragg mirrors with sub-structured internal cavities or Bragg elements

optical nanostructuring, 3D nanoprinting,
polymer-air/gas Bragg mirrors

DESCRIPTION OF TECHNOLOGY

The invention presented herein comprises polymerbased Bragg mirrors which have one or more internal substructures being different from the main structure of the Bragg mirror. These substructures („microcavities“) may have a different geometrical orientation or variation of the polymer layers/structures within them or may be filled with a different optical medium between the polymer layers. – Or they may exert even both ways of variation of the substructure in combination. By substructuring Bragg mirrors in such ways, it becomes possible to modulate an oncoming electromagnetic wave front regionally or spectrally in different ways at once, for example splitting it up into different sub-rays and leading them out of the Bragg mirror into different directions or reflecting and transmitting desired spectral components according to specific sequence modulation designs. Because the polymer layers are to some degree flexible, the optical properties can also be modulated by pressure, providing modulable mirrors/cavities.



© Dr. Rahimi-Iman – JLU (REM-pictures of diverse examples with overlayed artistic representations of possible ways of modulation of electromagnetic waves

Manufacturing of these substructred modulable Bragg mirrors is done via 3D nanoprinting, applying the method of two-photon absorption. By doing so, a precise control of the geometry of the polymer micrometer layers is achieved. By performing the sequential printing steps within a gas-tight housing, different gas atmosphere configurations within cavities of such structure can be variably targeted during manufacturing, promising different media enclosable within such photonic Bragg mirrors.

AT A GLANCE …

Application Fields

- Optical cables / Endoscopy
- Optoelectronic components / optical computation
- Optical sensors

Business

- Optical Telecommunication and Lighting, Light filtering (Optics)
- Medicine (Endoscopes)
- Environmental analysis
- Light harvesting (Photovoltaics)

USP

- Low-weight polymer micromirror
- Positioning, structuring and spectral flexibility
- Optical status accessible through light irradiation on Bragg structures from nearby without contact in free-space application or through attached optical fibers (measurement quality and distance depending on the geometries, feature sizes and signal requirements)
- Disposable microstructure end facettes of (medical) endoscopes.
- Cross sectional analysis of electromagnetic wave fronts

Development Status

- Examples are manufactured on laboratory scale and optical performance being proven by measurements.

Patent Status

Priority application filed on 12.07.2022 at the European Patent Office.

REFERENCE NO. **TM 1170**

APPLICATION FIELDS

The Bragg mirrors can be applied in many different areas, for example as:

- Sensing device for measurement of the surrounding environment. These Bragg mirror-sensors need no electric supply, for the influence of the surrounding environment is exerted without need of electricity and the read-out is also achieved from a feasible distance via laser radiation directed towards the Bragg mirror sensor and analysis of the reflected photons.
- Disposable end facettes of endoscopes in medical diagnostics with light.
- Optic device for fine-structured modulation of optic beam packages over the cross section of the electromagnetic wave front through internal substructures.
- Broadband, narrowband or multispectral photonic mirror/filter from modulated layer and/or cavity sequences.

ADVANTAGES OVER THE PRIOR ART

Sensors being based on the modulable Bragg mirrors are being able to be read out optically, whereat the passive sensor needs no locally-integrated power supply.

The optical Bragg mirrors may be used as disposable filters/sensors/detectors/endoscope tips in medical diagnosis.

Modulating of an electromagnetic wave front can be achieved on a very small geometrical scale by propagation through structured internal regions, thus promising more compact optical data processing capabilities.

STATE OF THE PRODUCT DEVELOPMENT

Examples of the polymerbased Bragg mirrors are produced on laboratory scale and the quality of reflectivity being proven by measurements.

MARKET POTENTIAL

Bragg mirrors are widely used in optical devices and the polymerbased Bragg mirrors presented herein can also be used as sensing devices for surrounding parameters (e.g. pressure, gas atmosphere etc.) Thus, they are applicable in many areas, for example medical diagnostics, telecommunication, light-weight optics, optical computing, environmental analysis etc., so that they are considered to have a remarkable market potential.

COOPERATION OPPORTUNITIES

On behalf of its shareholder Justus-Liebig-Universität Giessen TransMIT GmbH is looking for cooperation partners or licensees for further development in Germany, Europe, US, and Asia.

A TECHNOLOGY OF

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Contact

TransMIT Gesellschaft
für Technologietransfer mbH
Kerkrader Straße 3
35394 Gießen
GERMANY
www.transmit.de

Contact Person

Dr. Andreas Fuß
Tel: +49 (0) 641 9 43 64 58
Fax: +49 (0) 641 9 43 64 55
E-Mail: andreas.fuss@transmit.de

TransMIT
Gesellschaft für
Technologietransfer mbH

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