Fiber Bragg Grating Sensors (FBGs)

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FBGs: Wind Power Plant Monitoring

Sensors for enhanced energy efficiency

Sensors for testing new blade designs
FBGs: Wind Power Plant Monitoring

What?
- structural health monitoring
- 3D-load and strain monitoring
- detection of blade icing
- active pitch control

Why fiber optical sensors?
- not effected by electromagnetic field
- sensor networks
- easy to install and low costs
Fiber Bragg Grating Sensor - concept

Bragg condition

$$\lambda_B = 2n_{\text{eff}}\Lambda$$

$$\Lambda:$$ grating period
$$n_{\text{eff}}:$$ effective refractive index
FBG sensors – our concept

What?
- miniaturization
- low energy consumption
- less weight
- low costs
- mass production

How?
- telecom components (1.5 µm)
- silicon chip wafer technology
Femtosecond Laser FBG Processing

Femtosecond laser waveguide processing

- Strongly absorbed
- Weakly absorbed
- Locally absorbed, i.e. via multiphoton process

Fiber Bragg Grating (FBG)

Fs-Laser

Schutzmantel

Faser-Bragg-Gitter

Fasermantel

Cladding

Faserkern
Femtosecond Laser FBG Processing
Miniaturized FBG Interrogator System

Polymer based arrayed waveguide (AWG) chip spectrometer
Lab on a Chip Design

Fibre Optical Sensor Systems

Si-AWG-FBG-Chip
FBG Condition Monitoring

Fibre Optical Sensor Systems
## FBG sensor specifications

- temperature \( \Delta T < 0.1 \text{ K} \)
- strain \( \varepsilon < 25 \mu \text{m/m} \)
- vibration \( \Delta \nu < 0.1 \text{ Hz} \)
- frequencies \( 1 \text{ Hz} \ldots 500 \text{ kHz} \)
- 3D profiles \( \Delta x,y,z < 1 \text{ mm} \)
- acceleration \( \Delta a < 0.1 \ldots 0.01 \text{g} \)