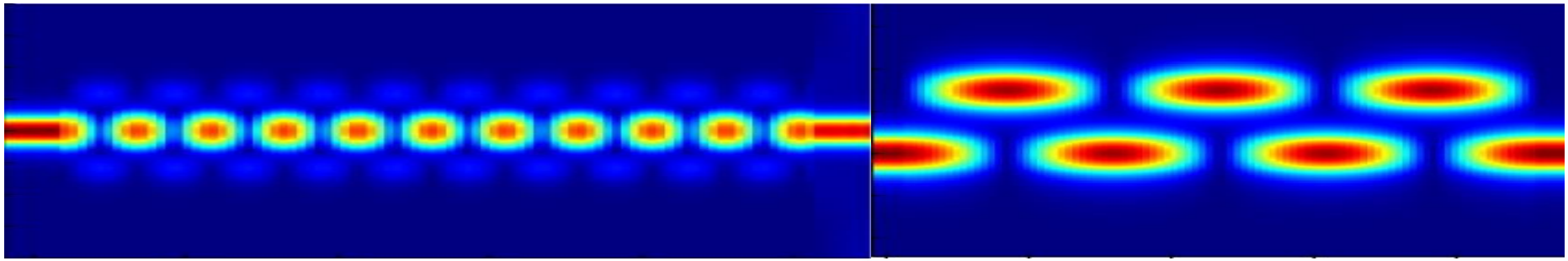

Coupled-core Optical Fiber Sensors

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Meeting on Fiber Sensors
19-20 April 2023, Porto, Portugal

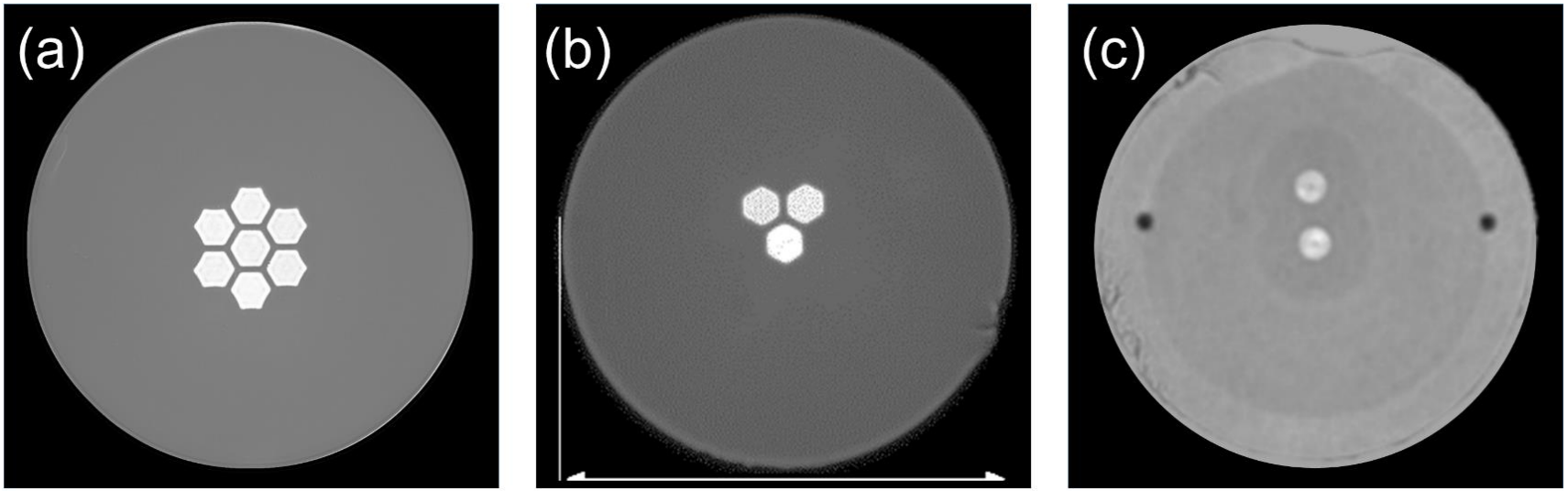
The **paradox** of fiber sensors

1. Optical fibers have **intrinsic sensitivity** to temperature and strain.
2. Optical fibers are cheap; sensors are **expensive**.

Solutions:

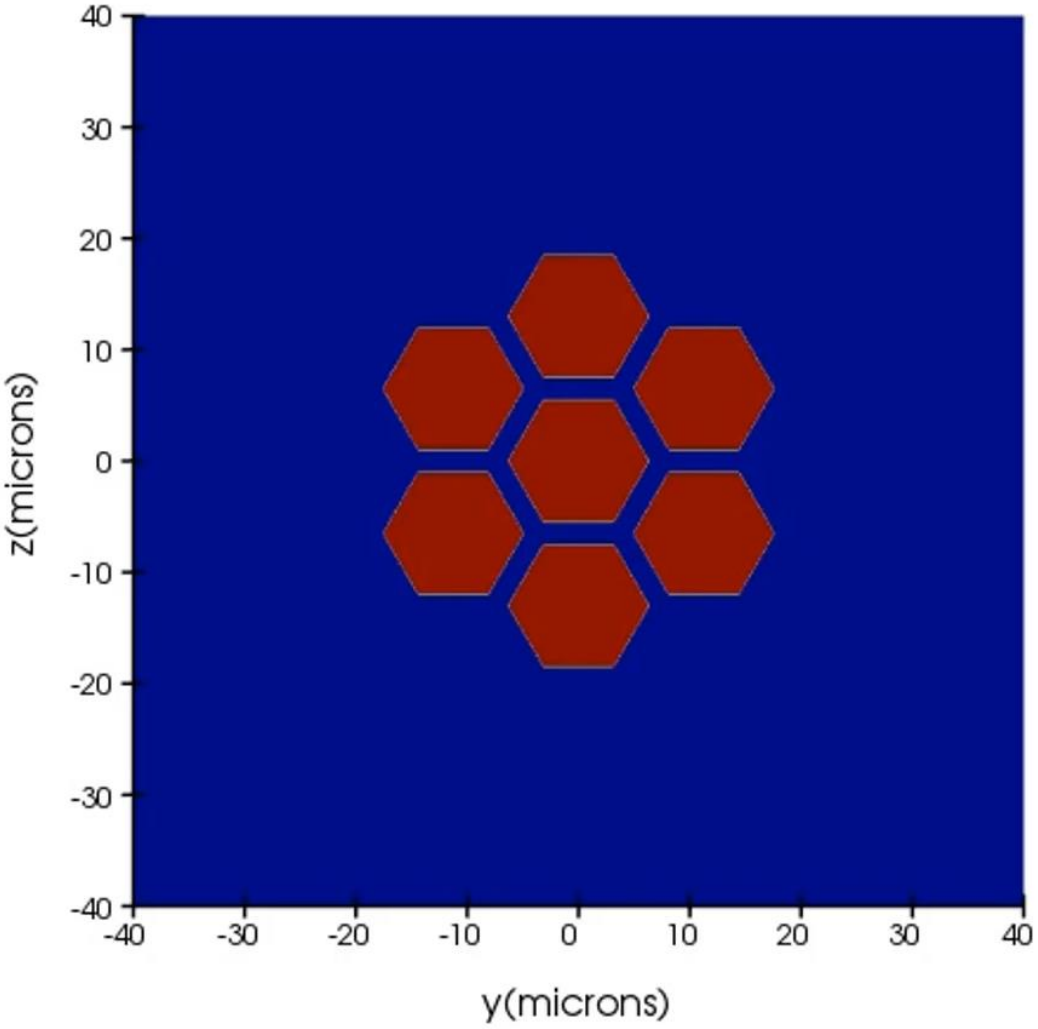
1. To use a **reference** sensor.
2. To develop **multi-parameter sensing** platforms.
3. To use **specialty optical fibers**.

Coupled-core optical fibers

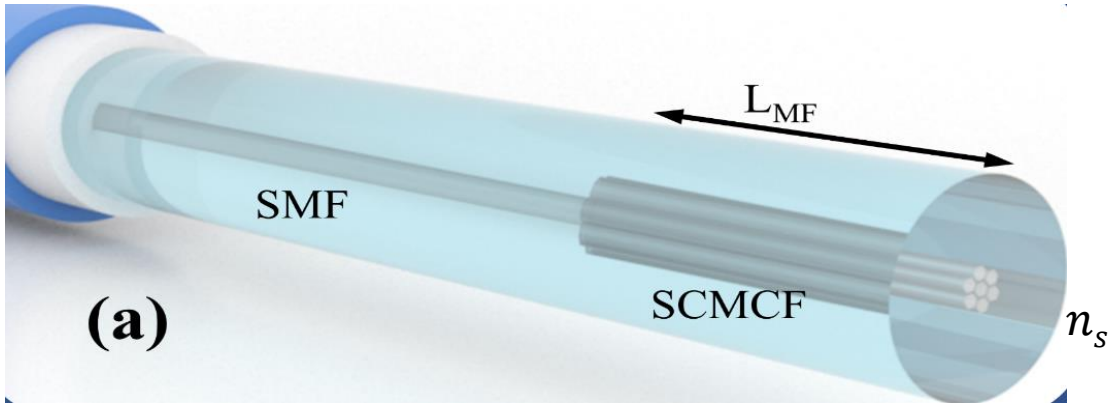


- CCFs support **supermodes**
- They can be treated as MMF

Supermodes in CCF



Coupled-core fiber interferometer

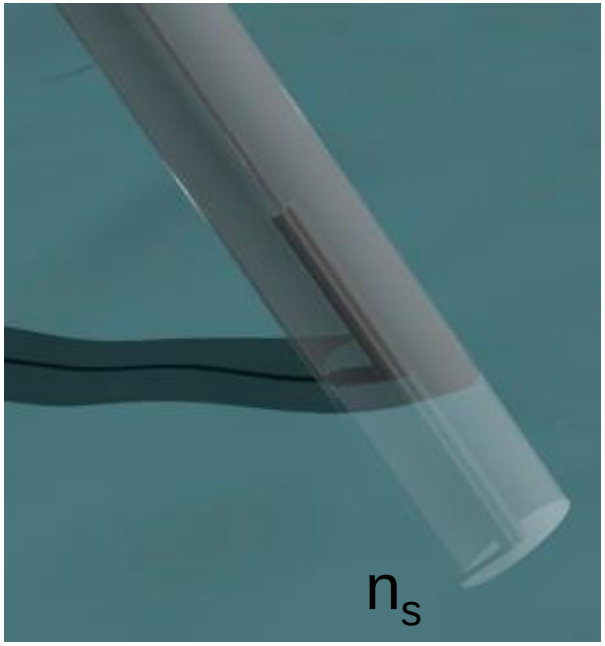


$$R(\lambda, n_s) = R_F(n_s)\cdot[1 + V\cos(2\Delta\phi)]$$

Depends on sample's RI

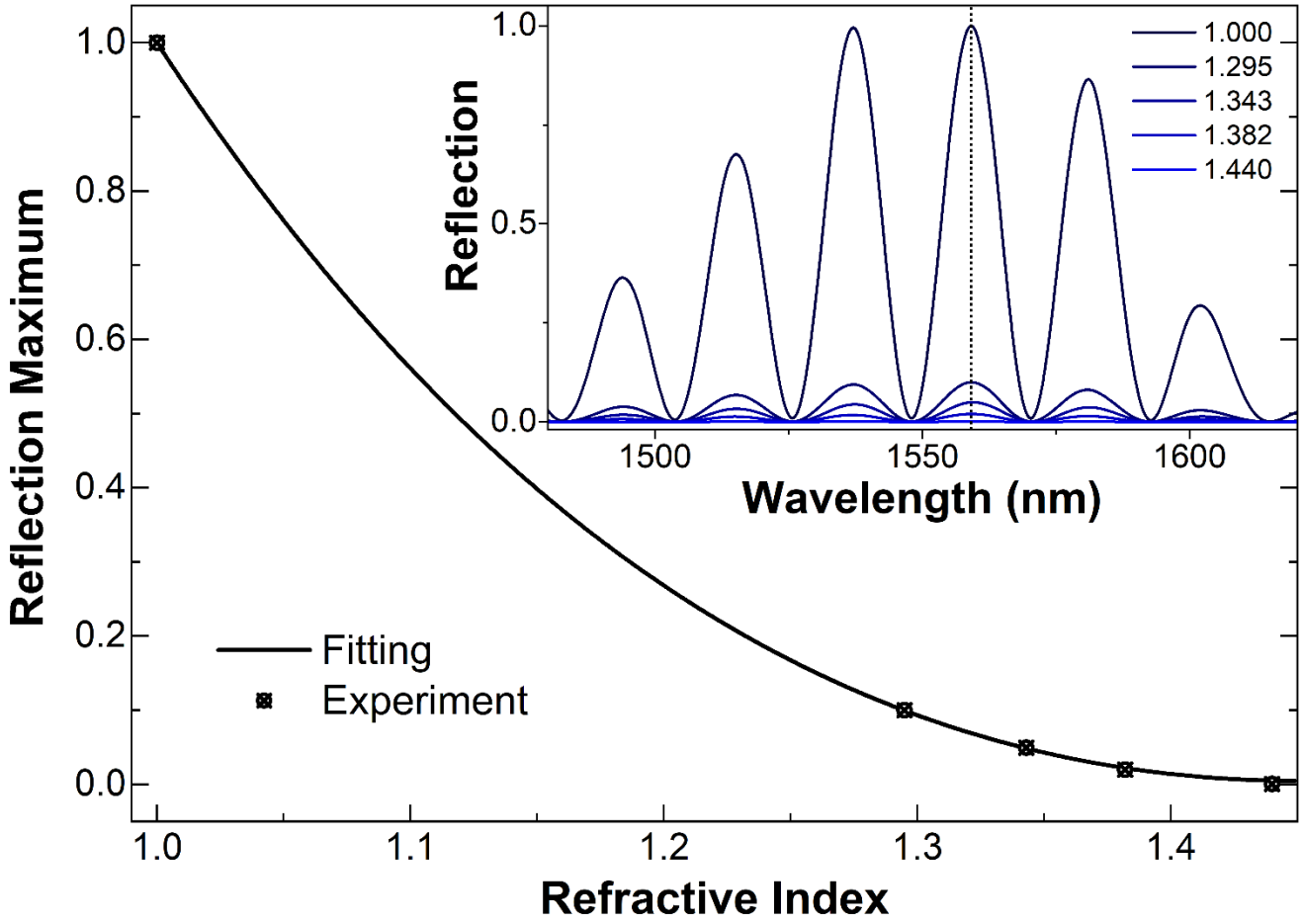
Depends on temperature

What do we expect?



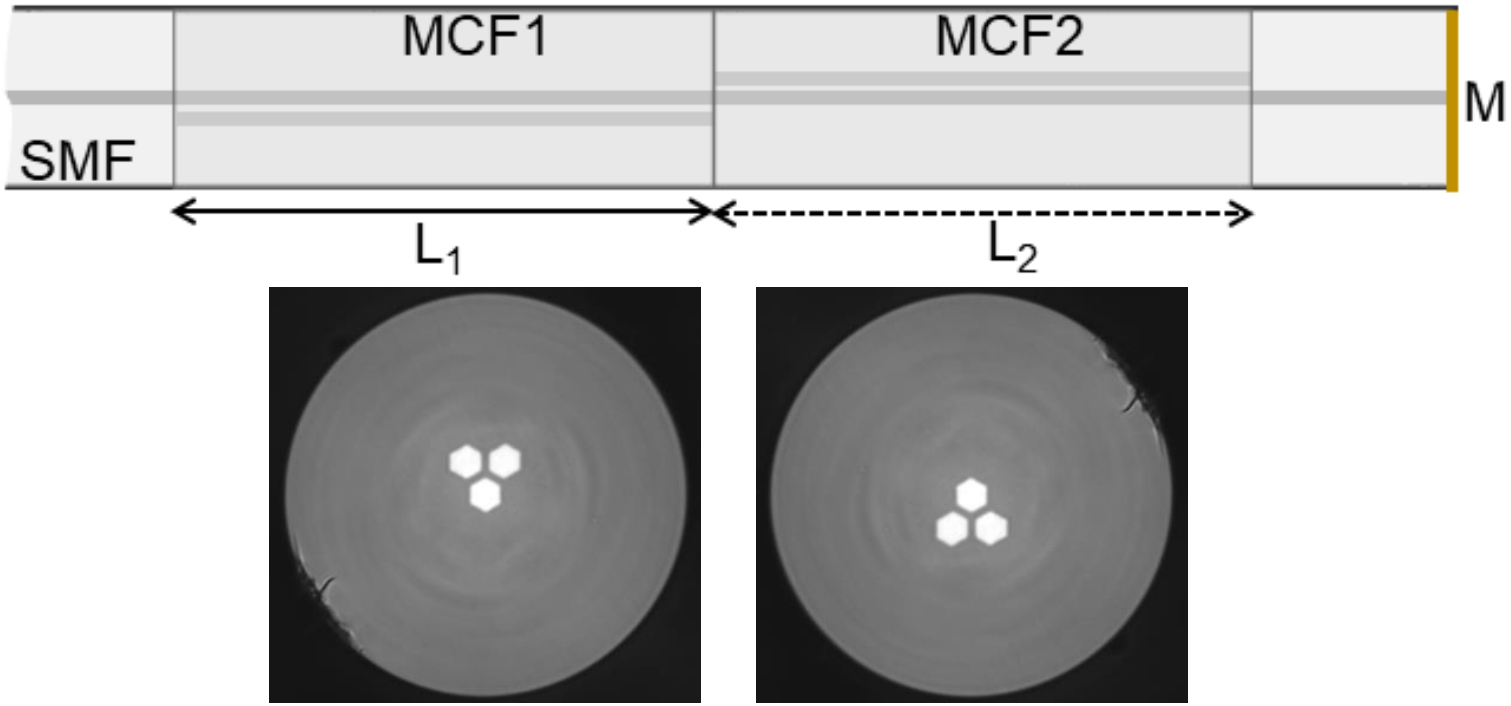
The amplitude of the interference pattern changes with n_s.

Experimental results



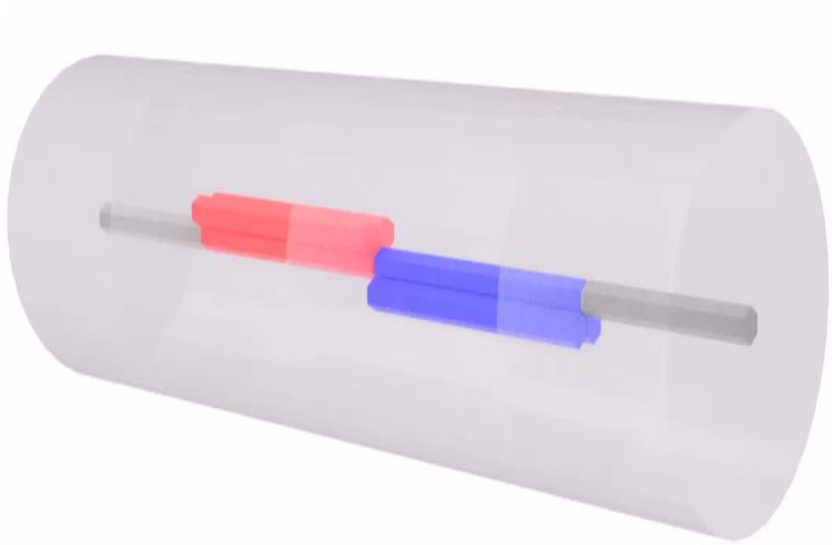
$$n_s = n_c\left(1 - \sqrt{R_1 \boldsymbol{R}_m}\right)/\left(1 + \sqrt{R_1 \boldsymbol{R}_m}\right)$$

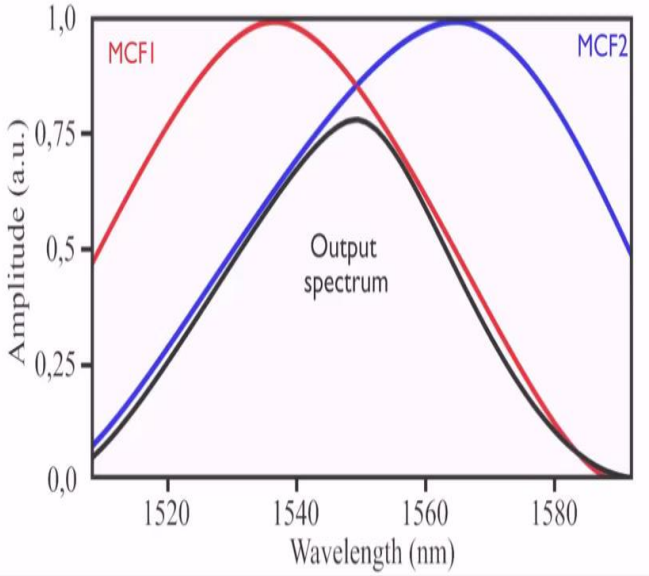
Two better than one



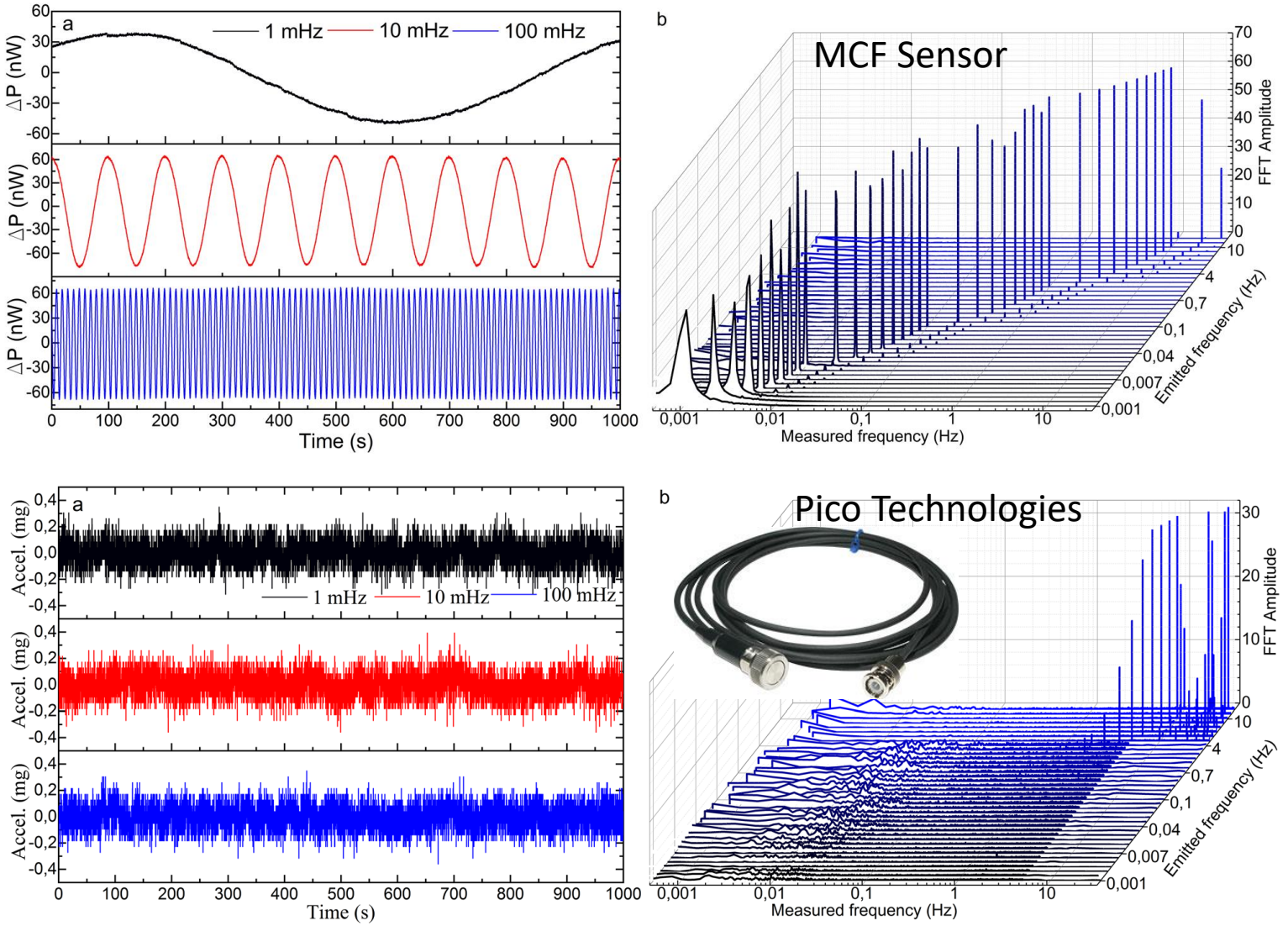
J. Villatoro et al., APL Photonics **5**, 070801 (2020)

How does it work?

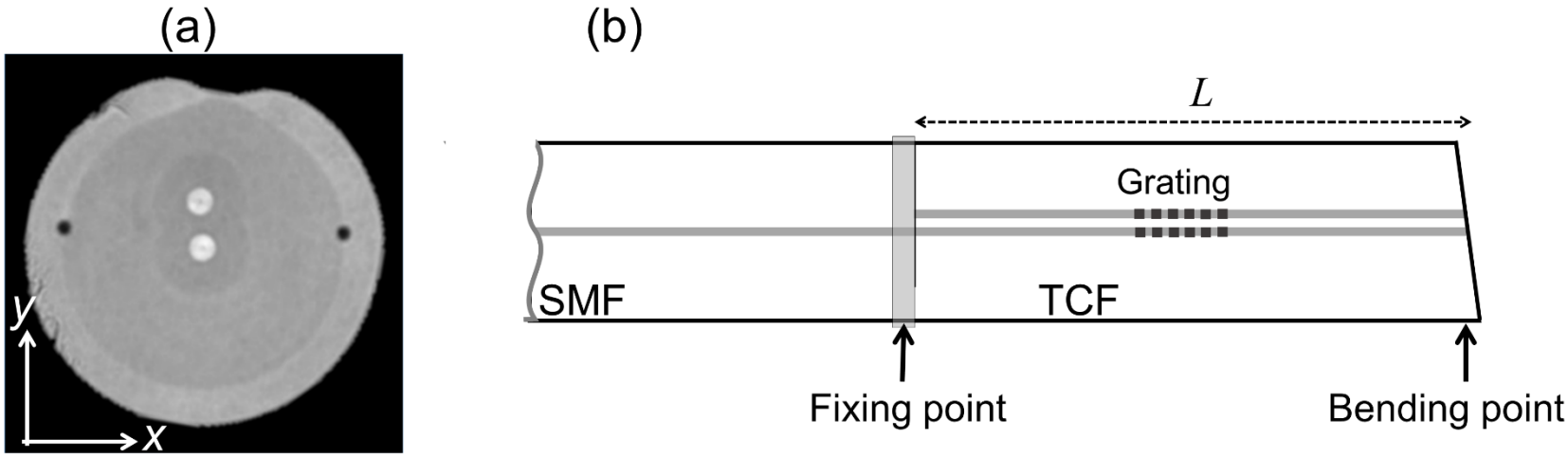




CCF sensor vs electronic sensor



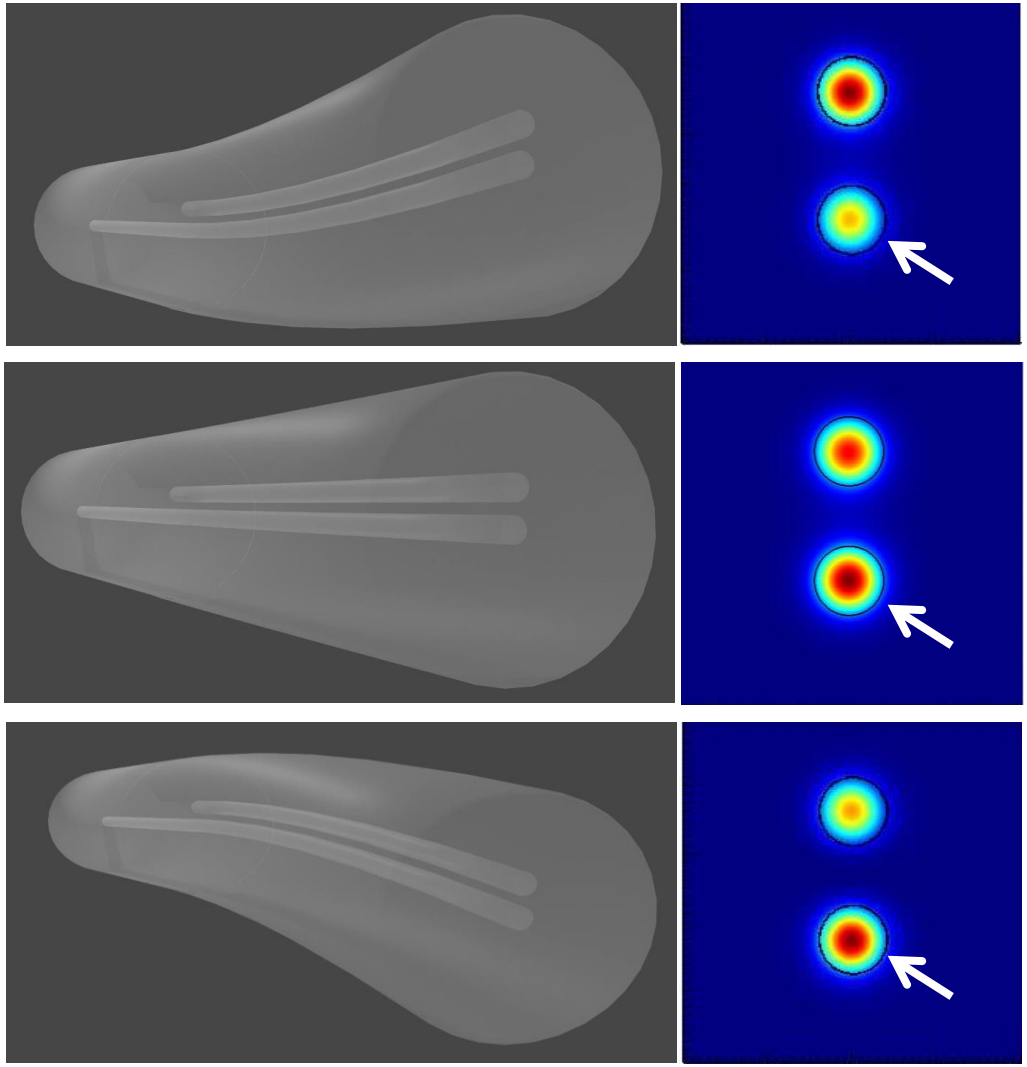
Coupled-core fiber Bragg gratings



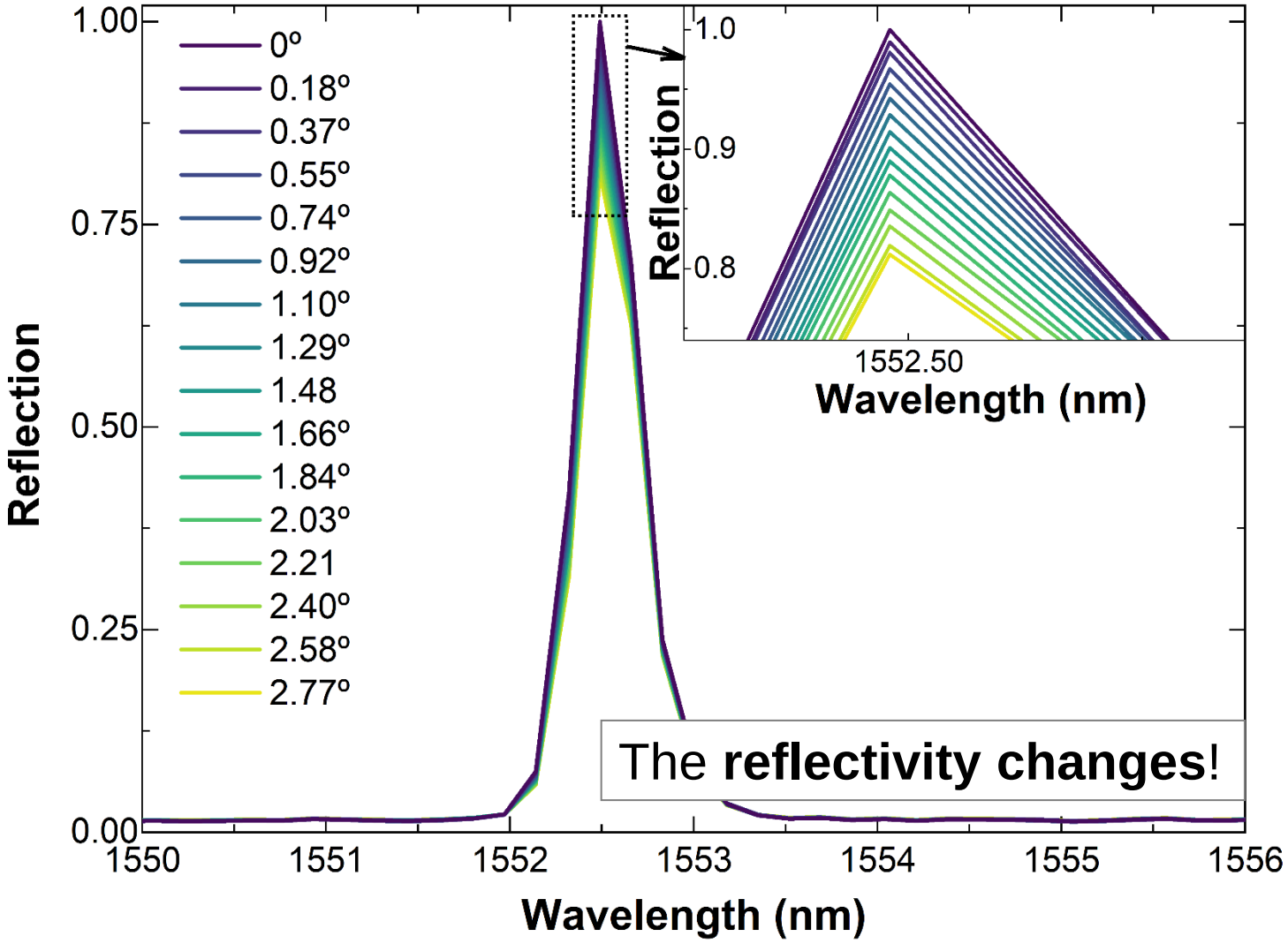
The Bragg gratings are inscribed with conventional methods.

J. Villatoro, S. Sales, J. Madrigal, ***Patent*** *No. PCT/EP2022/062066*

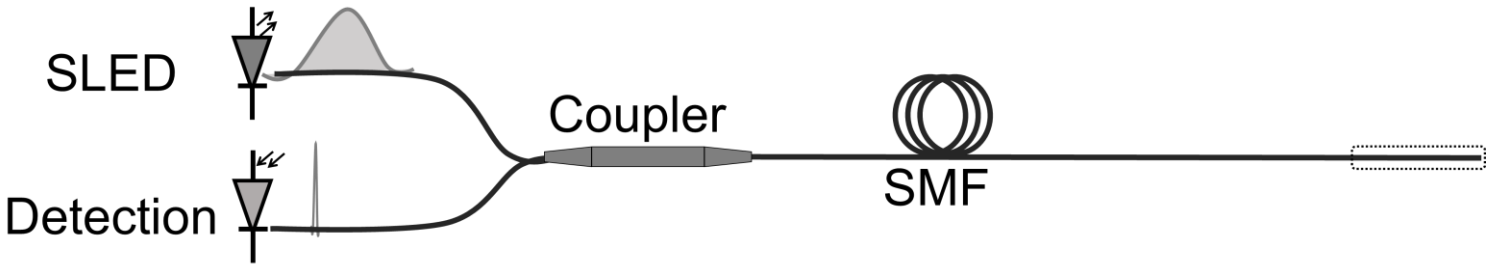
Bending effect on the TCF



Bending of TCF Bragg grating

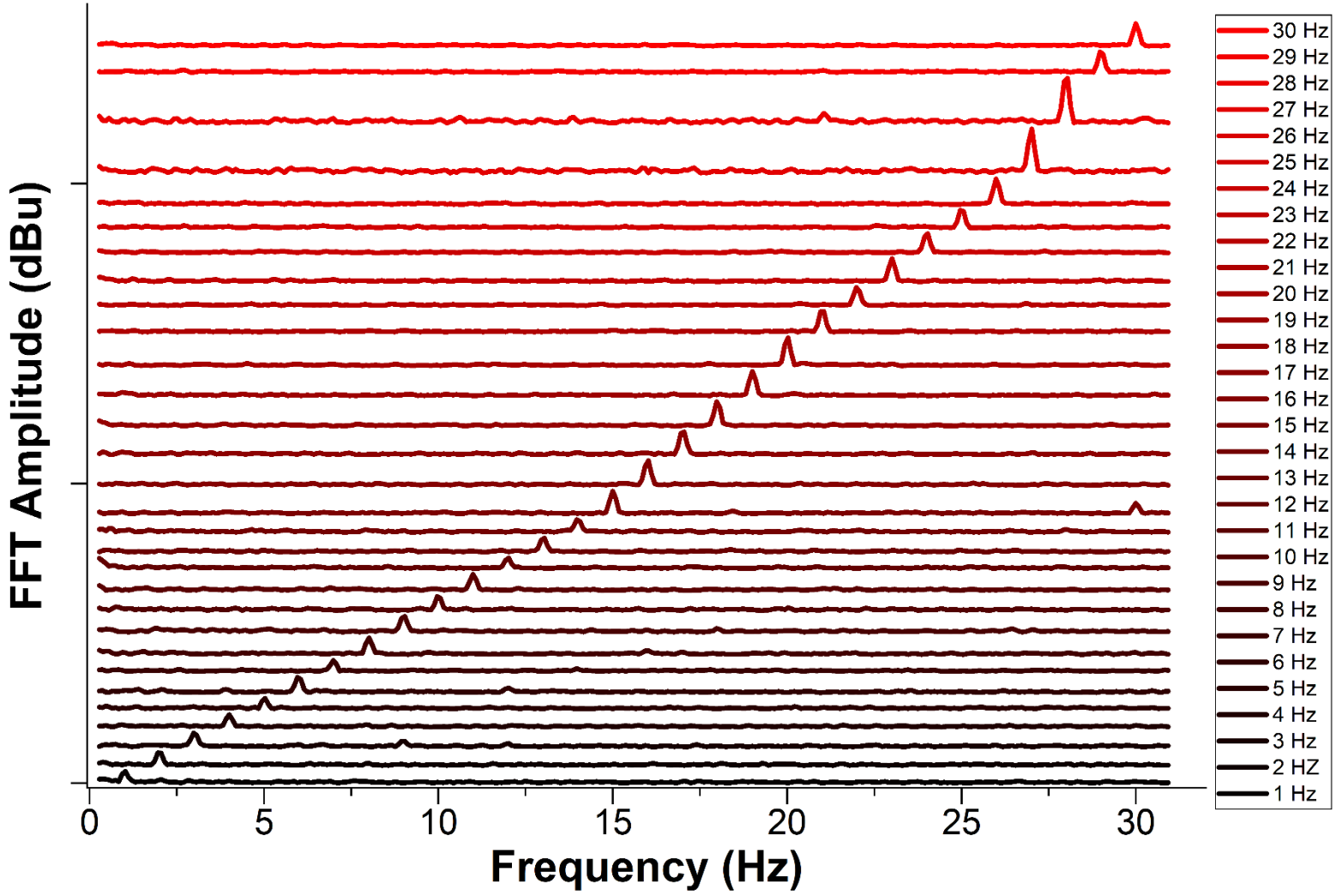


Interrogation of TCF Bragg grating



A **simple photodetector** is needed to monitor reflectivity changes!

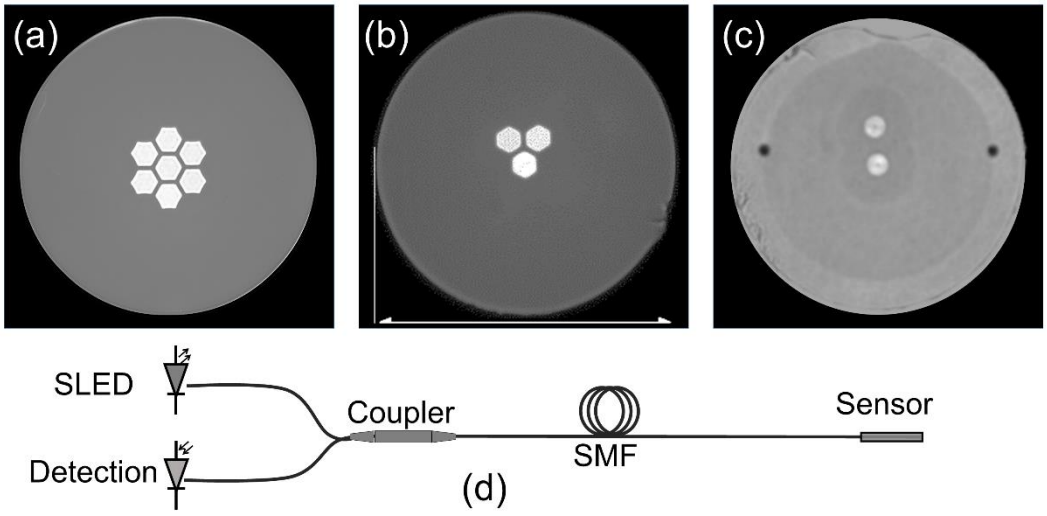
Low-frequency vibration sensing



Conclusions

Coupled-core fiber sensing

- Simple, reproducible sensor fabrication process
- **Cost-effectiveness**
- *Dual parameter sensing (intrinsic reference)*
- **Temperature-independent devices**



Acknowledgements to: