Industrial photonics

Assignment 04

Politecnico di Torino

A Review on Optical Fiber Sensors for Environmental Monitoring

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Environmental monitoring, nowadays is a must for most facilities. In the ones that happens to operate in **harsh conditions**, optical fiber sensors (**OFS**) have some great **advantages**:

- **resistance** to electromagnetic **interference**
- **resistance** under extreme **pressure**
- **resistance** under extreme **temperature**
- low **losses**
- small **sizes**

Cable layer vessel "Leonardo da Vinci"

Comparison between sensors

Electrochemical

- low power
- linear
- selective

Micro-electromech.

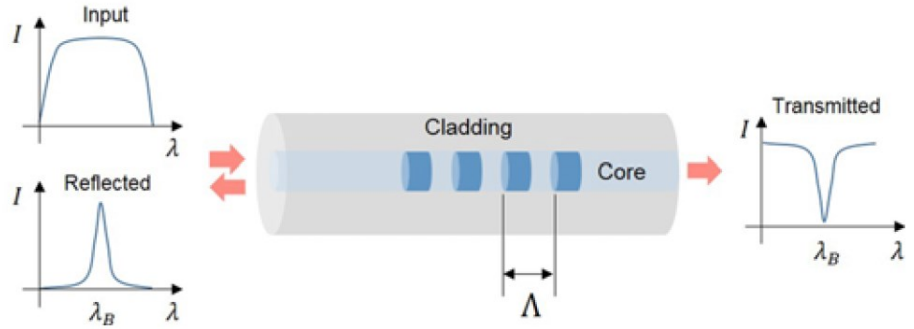
- small size
- cheap
- short life
- disturbance

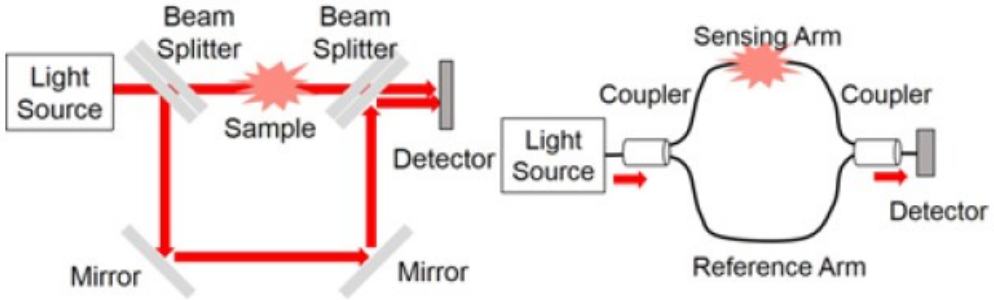
Optical fiber

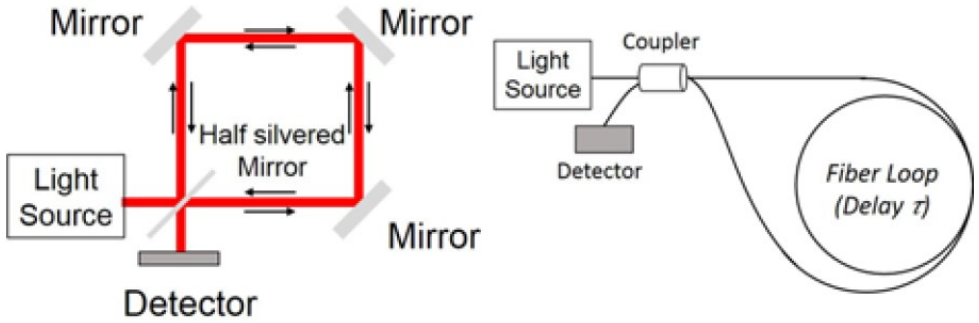
- high **bandwidth**
- compatible with existing infrastructure
- **resistance** to electromagnetic **interference**
- **resistance** under extreme **pressure**
- **resistance** under extreme **temperature**
- low **losses**
- small **sizes**

Types of OFS

- **Point-Based** – sensitivity / selectivity
  - fiber **gratings** (sensing T, ε, correlated)
  - **inline** interferometer (a lot of phis. quantities)
- **Distributed** – spatial and temporal domain
  - Optical **Time-Domain** Interferometer
  - Optical **Frequency** Interferometer
  - Scattering
    - Raileigh
    - Brillium
    - Raman



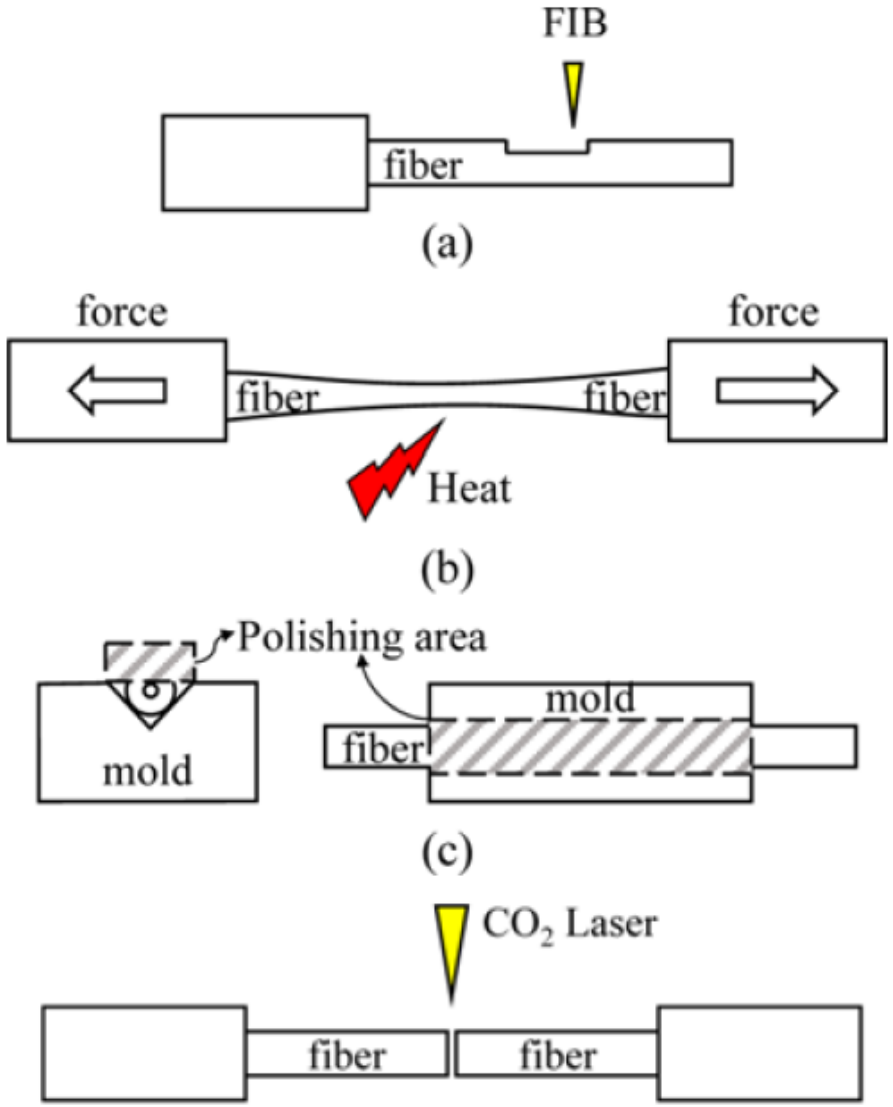




From Bulky equipment to fiber based

Fabrication process

- **Grating inscription**
  - Laser processing of the **core** of the fiber without damaging the **coatings**
  - Interference **lithography**
- **Functional coating**
  - **Physical** vapor deposition
  - **Chemical** vapor deposition
  - **Atomic** layer deposition
- **Shaping**
  - Machining
  - Tapering
  - Polishing
  - Splicing



Example of application

- **Earthquake** monitoring (or well)
- **Oil** and **Gas**
  - Leakages
  - Corrosion
  - Span **hundreds of km** with a **resolution** in the orders of **meters**
- **Civil**
  - **Dams/landslides/dikes**
  - **Structural** health monitoring
- **Aviation/Space**
  - **Real time** monitoring of **composite** materials
- **Agriculture**
  - **Air/Soil/Water/Chemical** monitoring