TELECOMMUNICATION

INTEGRATED PHOTONICS

PIOTR CEGIELSKI

PHOTONIC DEVICES IN EVERYDAY LIFE

AMO GmbH, AACHEN

AMO

SYNCHRONICS
SupramolecularY eNgineered arCHiterctures for optoelectRonics and photONICS

Festival della Scienza
Genova, 26 ottobre _ 5 novembre 2017
Contatti

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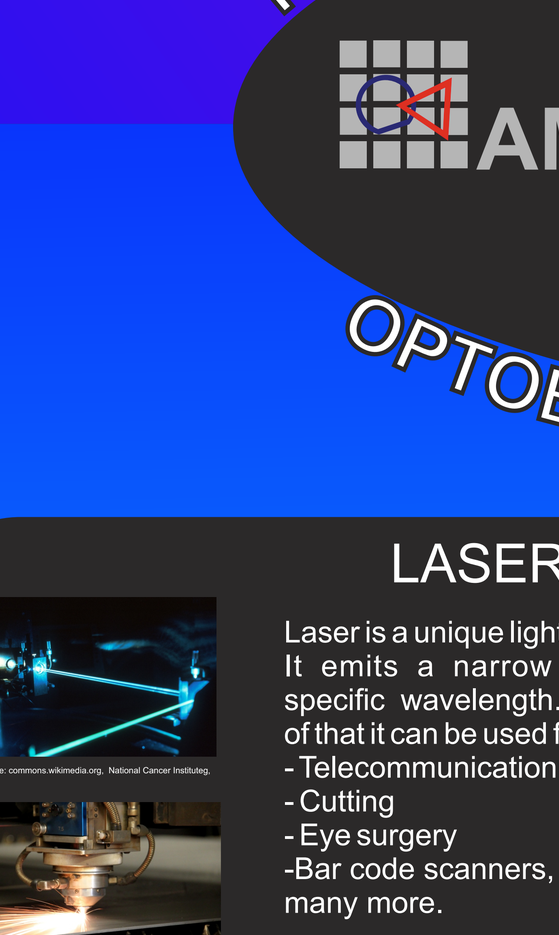
OPTOELECTRONICS

RESEARCH

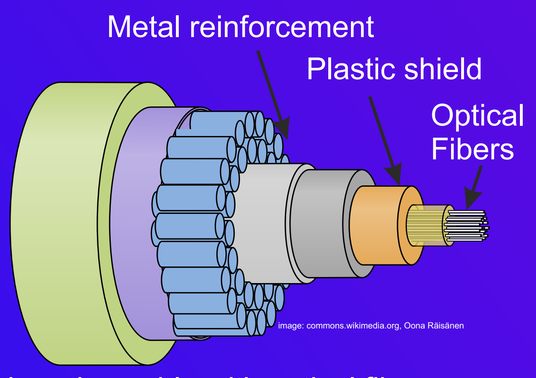
Optical telecommunication

Most of us is constantly connected to the Internet or at least uses it indirectly. The whole day! Starting from morning news, using public transport which uses internet to coordinate, at work or school researching for data and again at home watching TV streamed online. All this data at some point is transmitted by light.

Light can be guided by material with **high refractive index n** surrounded by low n material. When it hits the border at high angle it is reflected at the same angle. In this way the beam can travel inside the **waveguide**. This phenomenon is called **total internal reflection**



Optical communication is possible thanks to the **optical fiber.** It is made of high n glass (core) covered with low n glass (cladding).



Submarine cable with optical fibers

Optical fibers can carry much more data than copper cables, but are more expensive to deploy. This is why they are mostly used where there is large traffic: to connect a data center, two cities to each other or for submarine links.

Sending information with light

Transmitting optical signal starts with emitting light by a **laser**.

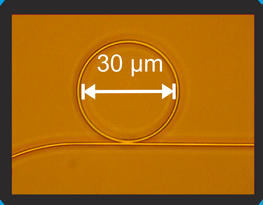
Separate signals are sent in a single fiber by **multiplexer.**

Optical fiber, which can be kilometers long. One fiber can carry even 100 signals at once.

Signals are seprated by a **demultiplexer.**

And converted to the binary code by **photodetectors.**

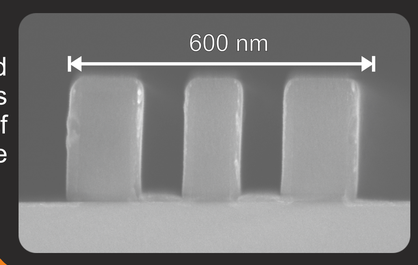
Integrated photonics



Ring resonator 3 times smaller than a human hair fabricated at AMO GmbH

Photonic devices are now miniaturized and now we can make 1000s of devices on an area of size of a fingernail. They can be mass produced and cheap. Soon, you can expect optical fibers to connect every home or components inside your computer!

Cross section of an integrated waveguide made at AMO. It's narrower than a particle of cigarette smoke



LASER

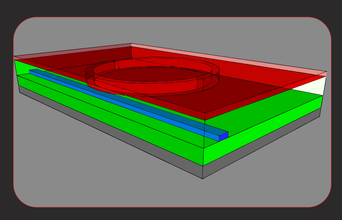
image: commons.wikimedia.org, National Cancer Instituteg,

image: commons.wikimedia.org, Metaveld BV

Laser is a unique light source. It emits a narrow beam at specific wavelength. Because of that it can be used for:
- Telecommunication
- Cutting
- Eye surgery
-Bar code scanners, and many more.

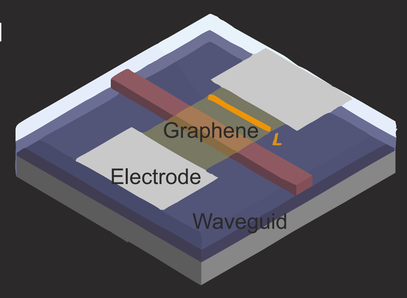
image: wikipedia.org

NANOPHOTONICS



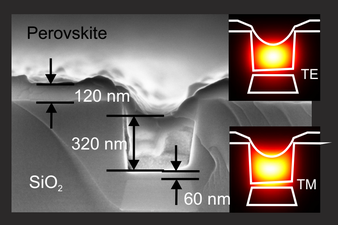
Opt Express. 2017 Jun 12;25(12):13199-13206. doi: 10.1364/OE.25.013199.

- Miniaturization = more optical communication instead of communication over copper wires = speed up!
- To keep up with growing internet traffic!
- Make data centers more energy efficient
- Speed up your computer
- :

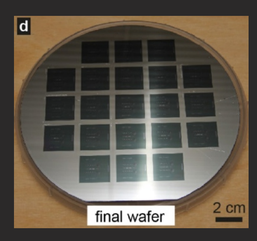


Daniel Schall et al 2017 *J. Phys. D: Appl. Phys.* **50** 124004

Low cost micro lasers made of a new material: mix halide perovskite.



Grapehene detectors fabricated on an industrial line for faster data transmission .

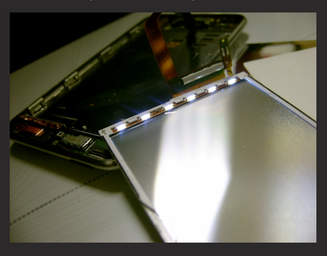


LIGHT EMITTING DIODES


image: commons.wikimedia.org, Eeppeliteloop

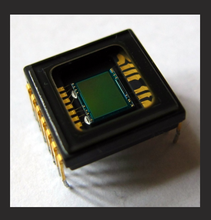
LED's do not emit single wavelength confined beam like LASERs, therefore they are used mostly for illumination.
You can find them in:
- Street lights
- Cars
- Back light of LCD screens and many more.

image: commons.wikimedia.org, ReTheCat



LED backlight in a smartphone.

CHANGING LIGHT INTO ELECTRIC CURRENT



Electronic devices like smartphones need something to convert light into electric signals, which they can processes. This is done by elements such as photodiodes or phototransistors.

CCD sensor of a smartphone camera.

NEW MATERIALS..

Organic LED TV with curved screen.

are constantly synthetized in chemical labs. Some are polymers suitable for flexible displays, other can be used for semitransparent solar panels integrated into buildings

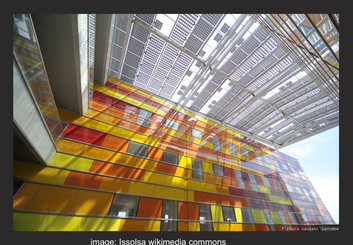


image: Issolsa wikimedia commons

Semitransparent solar cells integrated into a building.