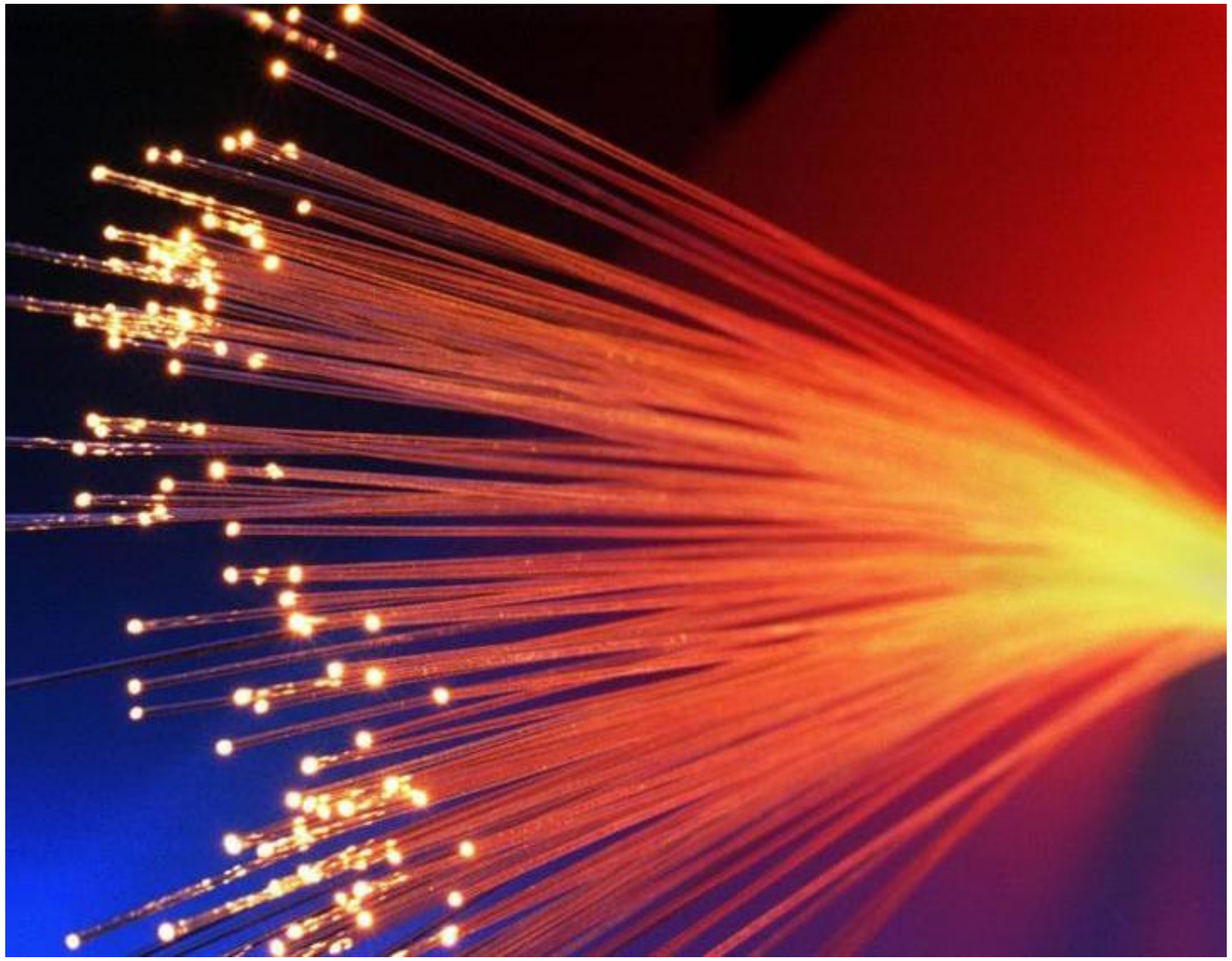
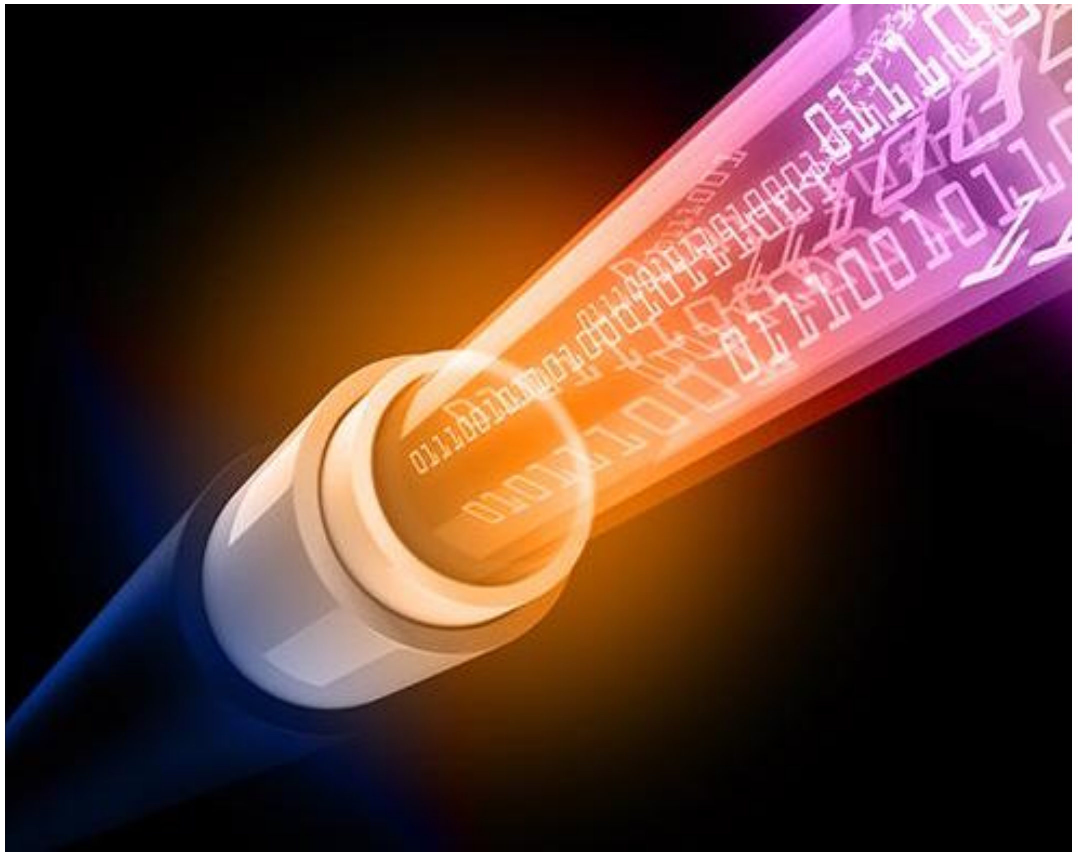
OPTICAL DEVICES FOR INFORMATION AND COMMUNICATION TECHNOLOGY

STAGE TORVERGATA UNIVERSITY 2016-2017

Why?

To take advantage of light speed to send informations all over the world





TARGETS:

- *studying guided optical principles*
- *studying the propagation and interaction between light and substance*
- *ideation and creation of an optical waveguide*

SOME OPTICAL NOTIONS

How to do?

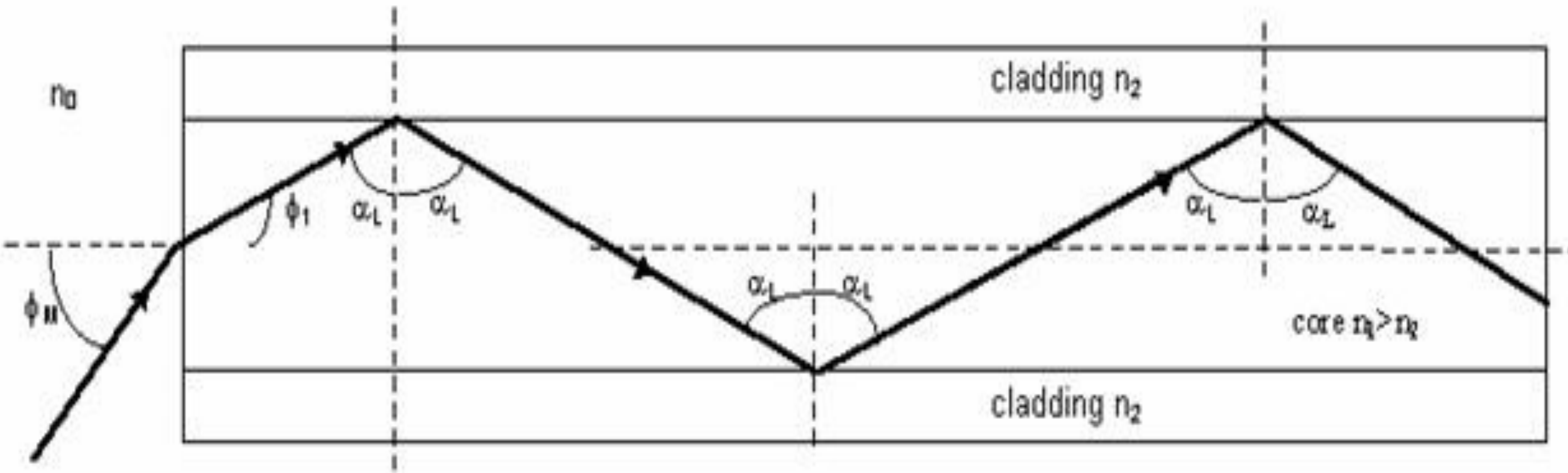
To keep the light into the waveguides we need to avoid the dispersion that light has every time it hits a surface.

*We remove the refractions with the **total internal reflection** derived by Snell's Law.*

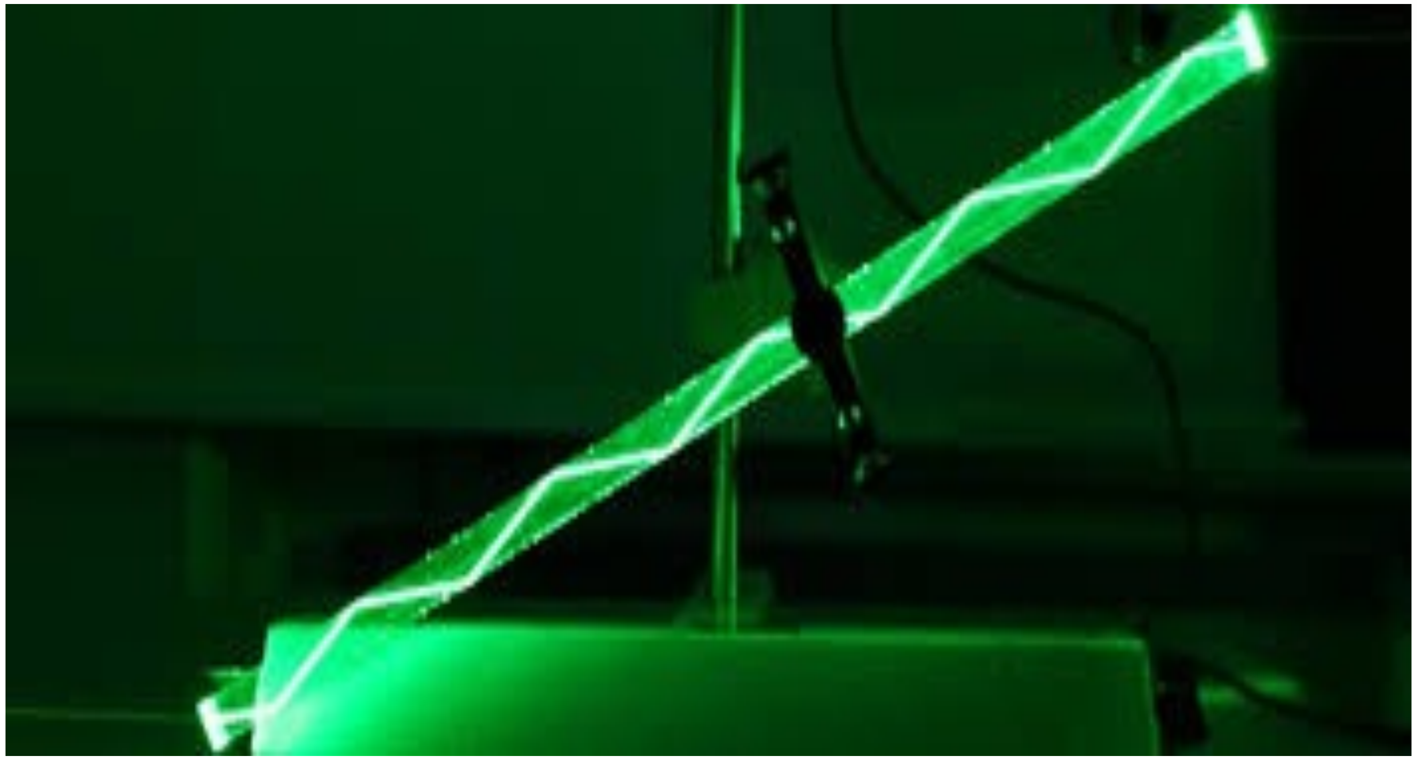
$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

Willebrord Snellius

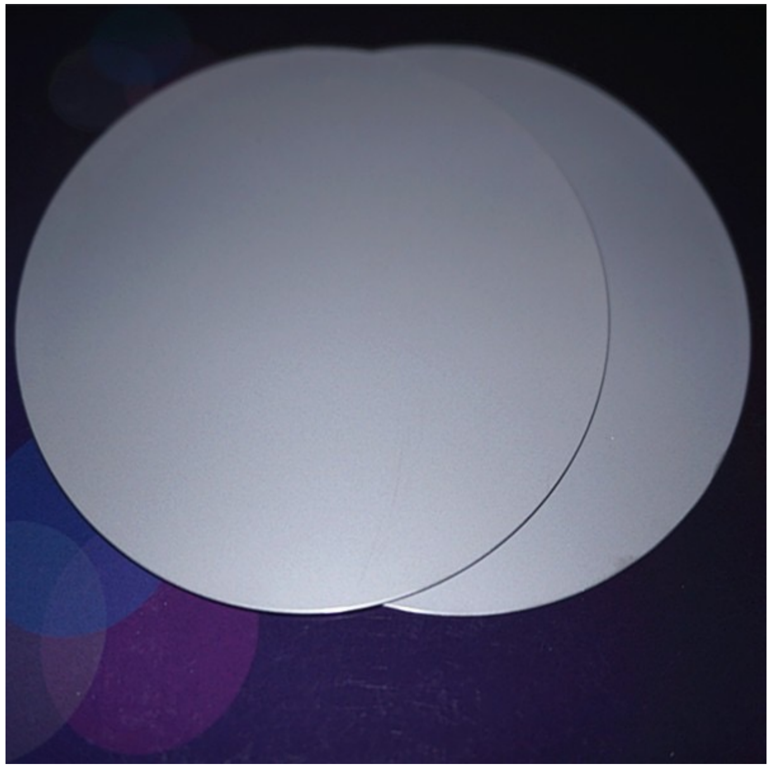
TOTAL INTERNAL REFLECTION



Specifically, we can obtain a total internal reflection for an angle greater than a "critical" one. This is possible only if the refractive index of the core is greater than the cladding layers.



LAB WORK



This is the silicon that we have used

To realise our cores we have prepared Zr/ GLY and Ti/TMSPM solutions. They are two hybrid compounds, which means that they are half organic half inorganic substances. These two compounds are going to become the films which will be deposed on the cladding, previously cut and accurately cleaned, made of silicon oxide on a silicon substrate.

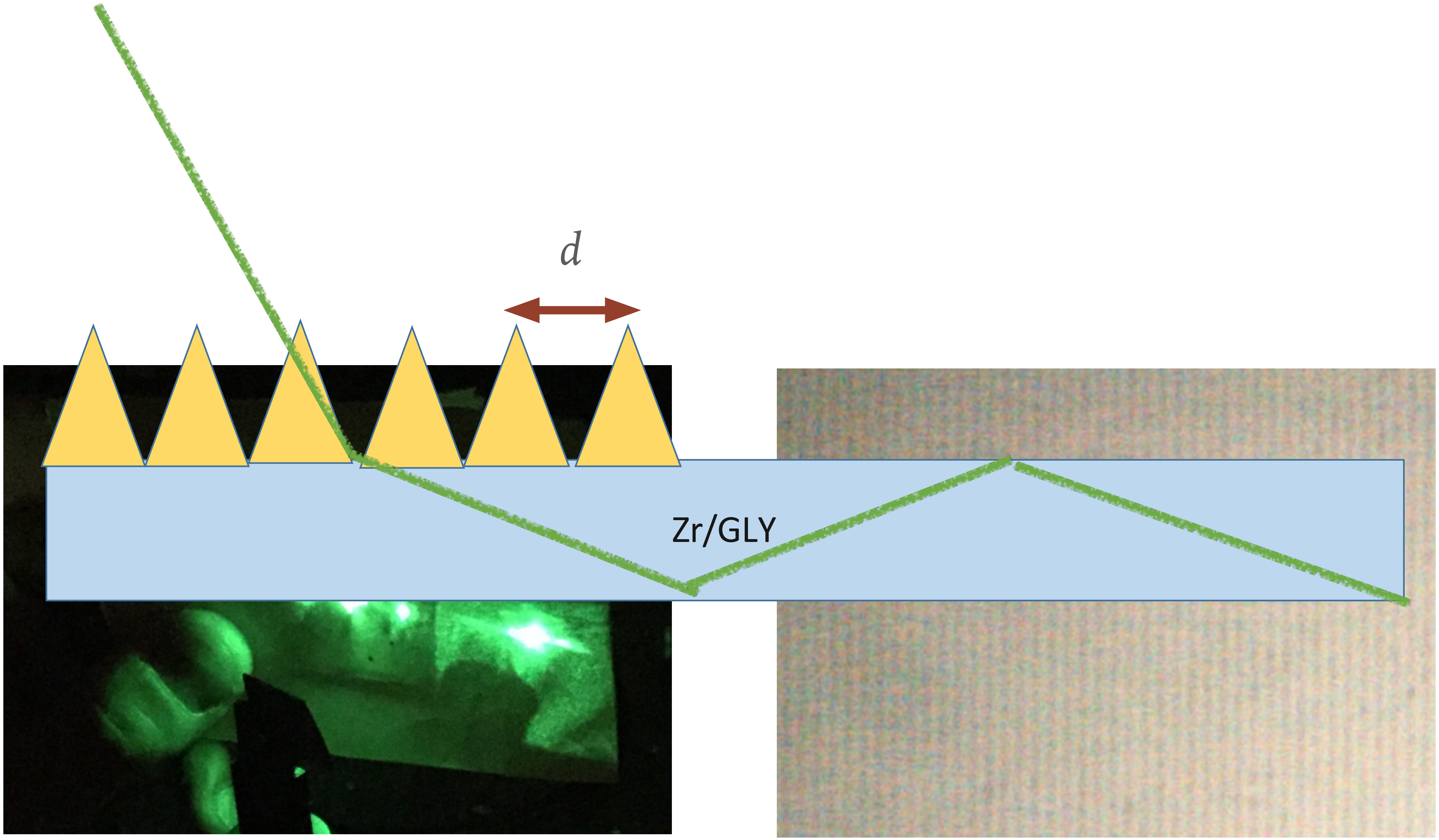
PREPARATION PROTOCOL

- *Zr/GLY film deposition, in a 10000 class clean room, using a Spin-coater for 30'' at 2000 rpm*

- *Baking at 110°C per 60'*

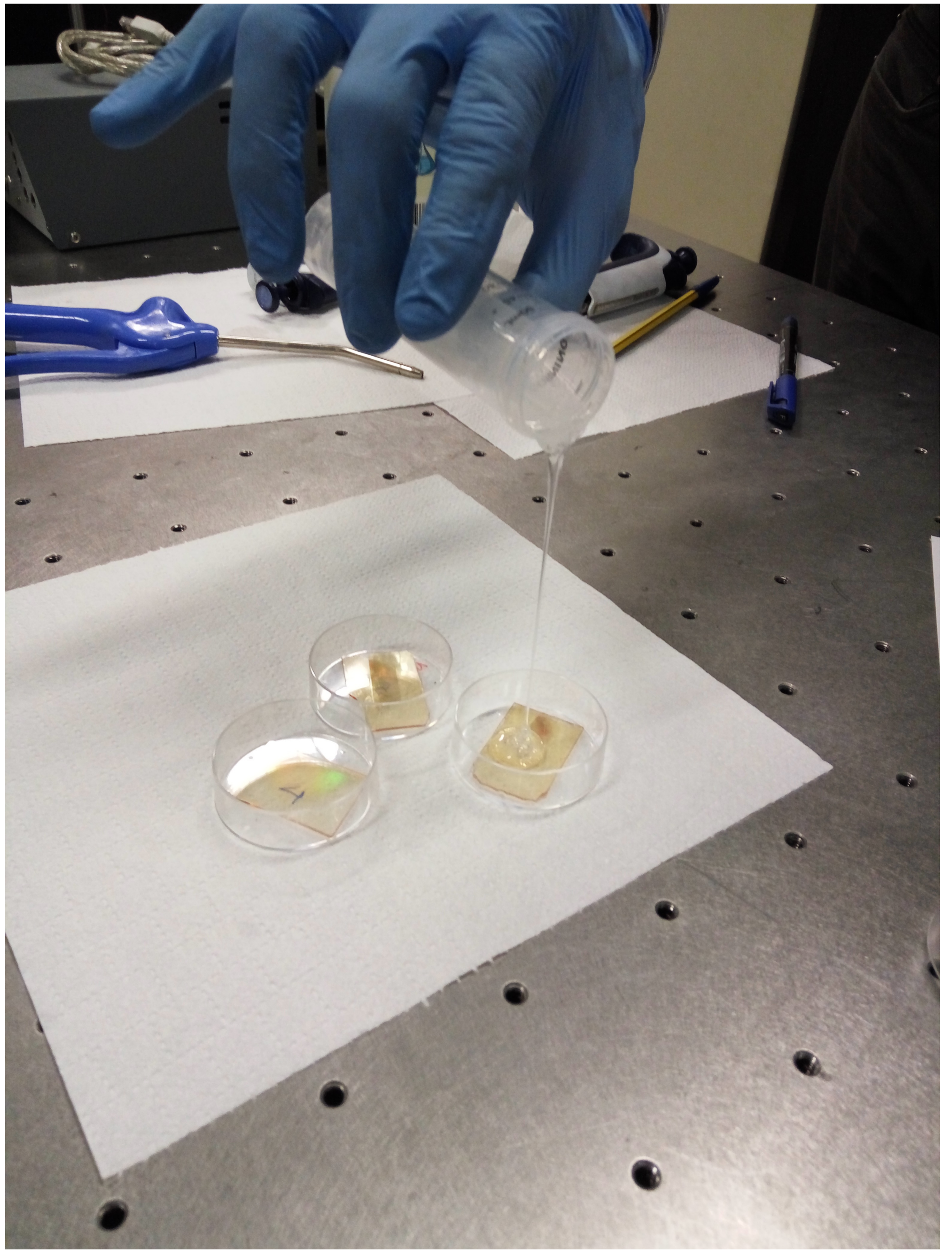
Does it end here? No, we have to find a way to insert the light inside the waveguide. This can be obtained through a diffraction grating.

DIFFRACTION GRATING



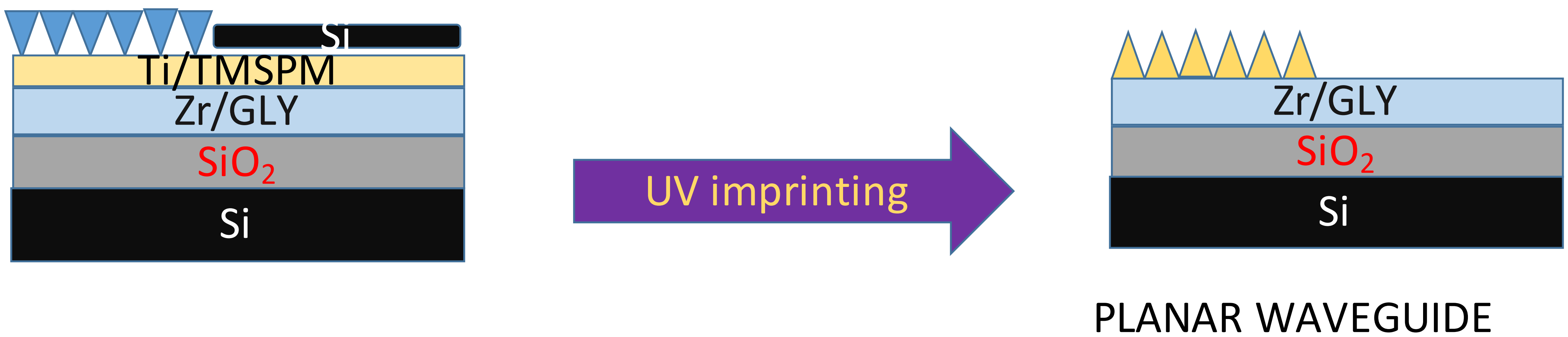
SOFT LITHOGRAPHY

- *Mold preparation with PDMS (two components glue)*
- *Ti/TMSPM deposition in a 10000 class clean room, using a Spin-coater for 30'' at 5000 rpm*
- *Pre-Baking at 85°C per 35'*
- *Optical photolithography process*



OPTICAL PHOTOLITHOGRAPHY PROCESS

- *UV imprinting in order to photopolymerize Ti /TMSPM and to impress mold gr*
- *IPA developing bath*



➤ *Post-Baking at 110°C per 45/50’*

OPTICAL CHARACTERISATION OF THE GRATING

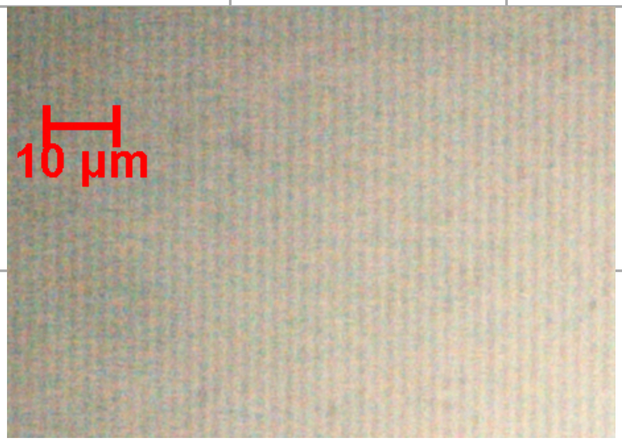
ANGLE OF DIFFRACTION				
ORDERS	θ°	- θ°	AVERAGE	d=mλ/sinθ
m=1/-1	15	16	15,5	1,99 µm
m=2/-2	31	32	31,5	2,04 µm
m=3/-3	49	51	50	2,08 µm
m=4/-4	86	91	88,5	2,13 µm

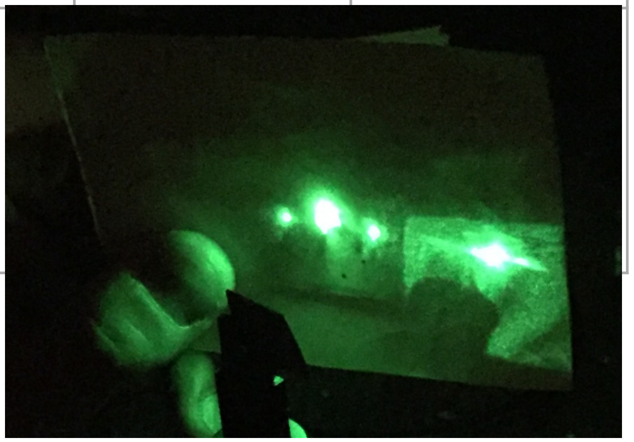
LEGEND
d= GRATING STEP
θ= MESURED ANGLE
m= ORDER OF DIFFRACTION
λ= WAVELENGTH (532nm)

d= 2,06
± 0,05
µm

An estimated value of "d" was also obtained from microscopy picture

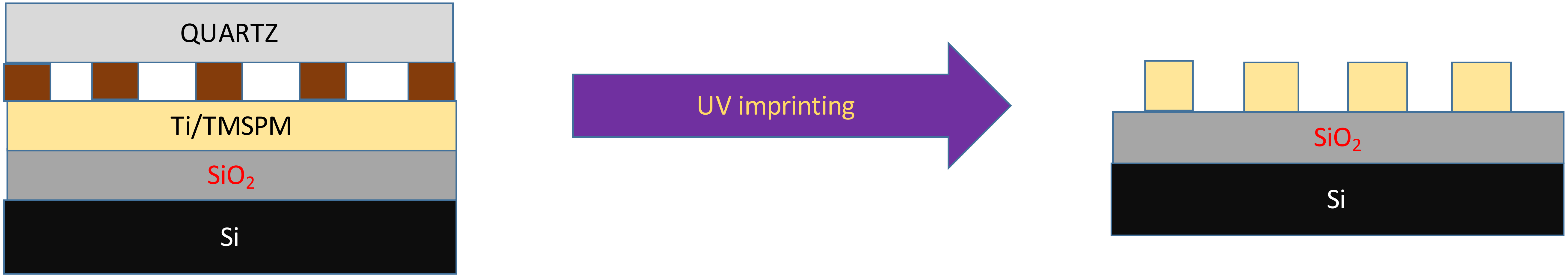
d= 2,08 µm





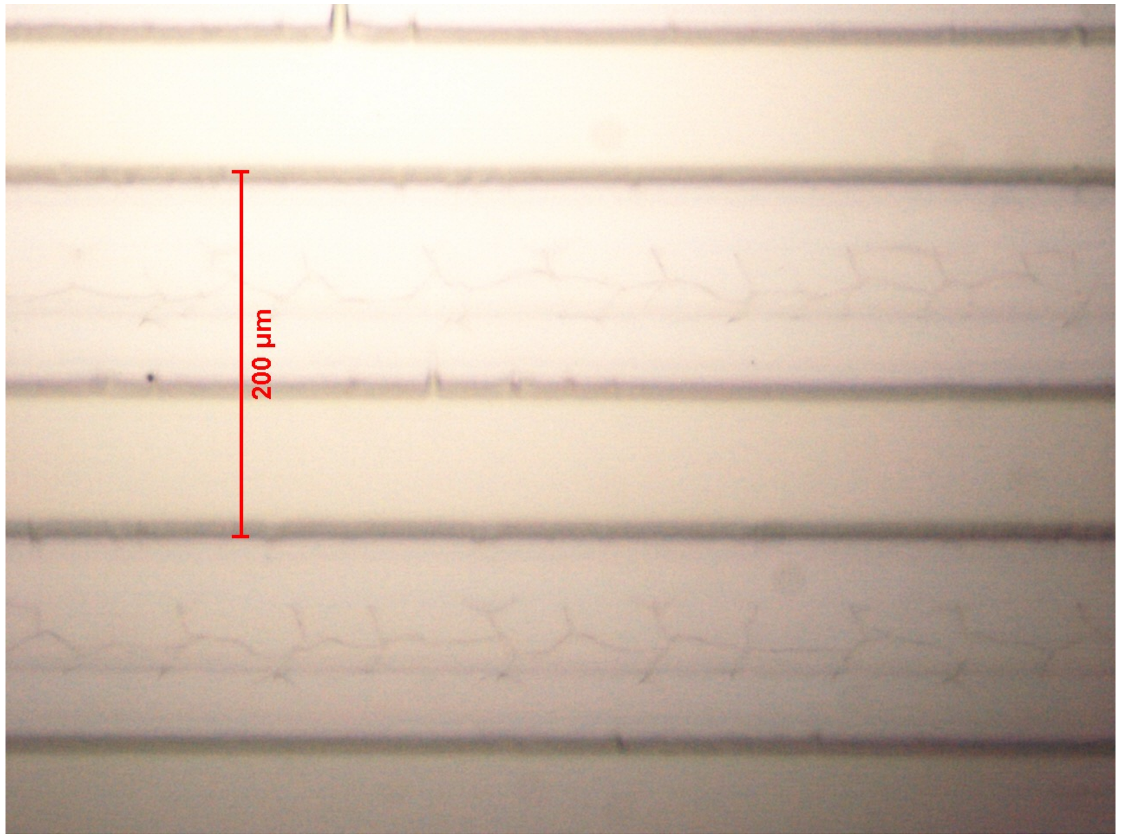
LIGHT COUPLED INTO THE PLANAR WAVEGUIDE

CHANNEL WAVEGUIDE



CHANNEL WAVEGUIDE

We can see that with the same process we make the channel waveguides



Conclusions

CONCLUSIONS

- Making planar waveguides with gratings on the top
- Coupling the light into the waveguide
- Characterisation of the grating
- Making channel waveguides (the characterisation next time)

TO BE CONTINUED…