FLOIM

Flexible Optical Injection Moulding of optoelectronic devices

Femtosecond laser fabrication of volume and surface-relief micrometric phase-gratings

FLOIM final event, April 28th, Munich

ceit

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

Outline

- Introduction

Introduction: Institutional profile

- ceit is an independent, private, non-profit Research and Technology Organization founded in 1982 by the School of Engineering of the University of Navarra

Motivation: FLOIM project

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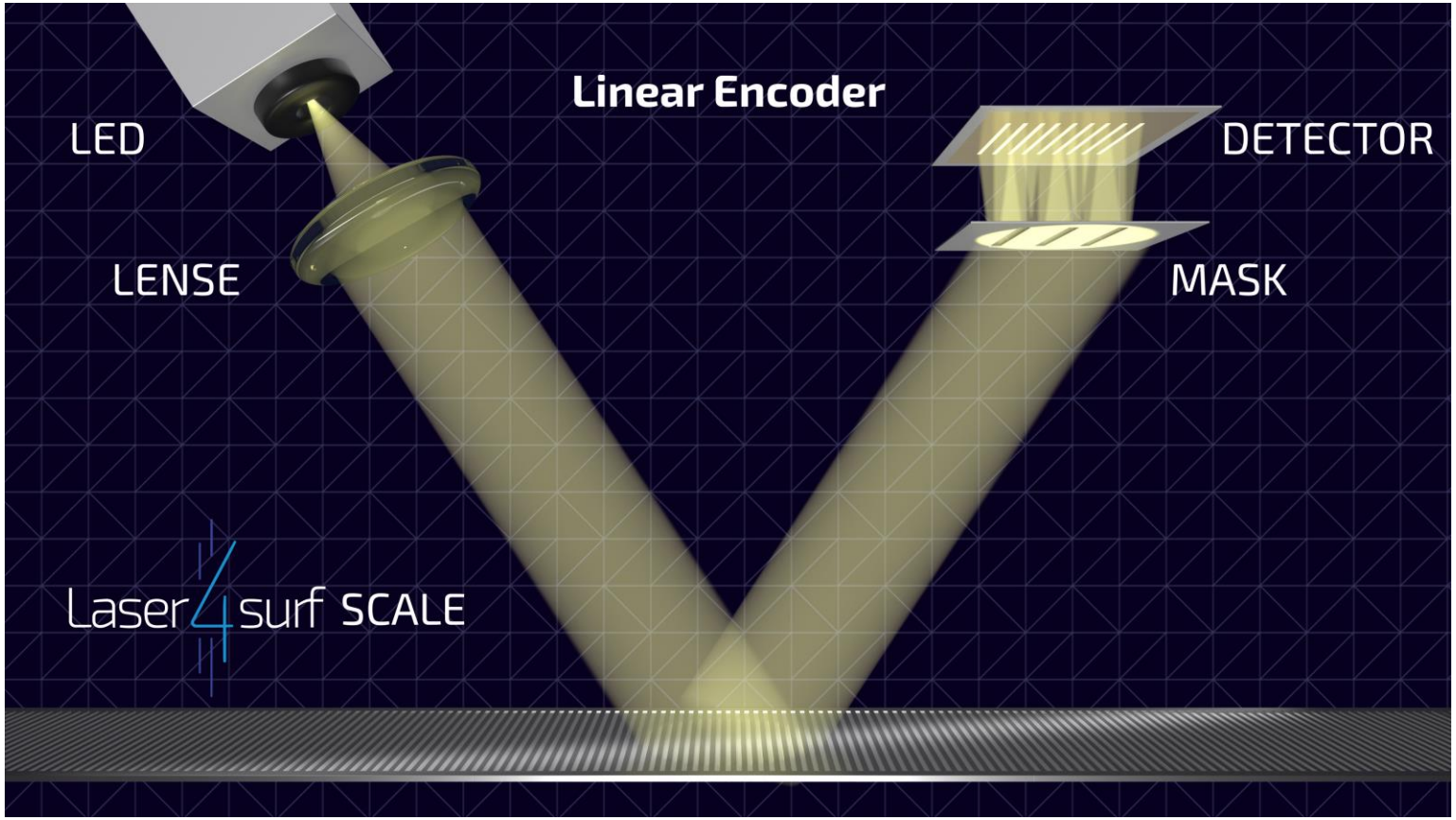
Factories of the Future Public Private Partnership

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820661

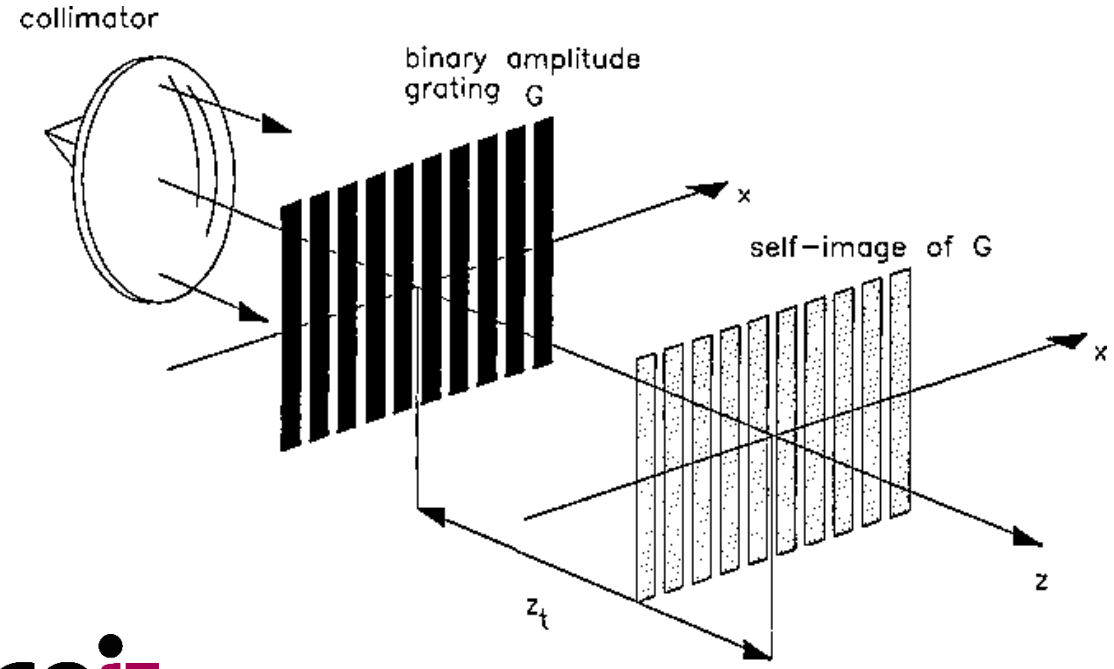
Motivation: Grating for Optical Encoder Head

- Grating needed for the optical head to work properly

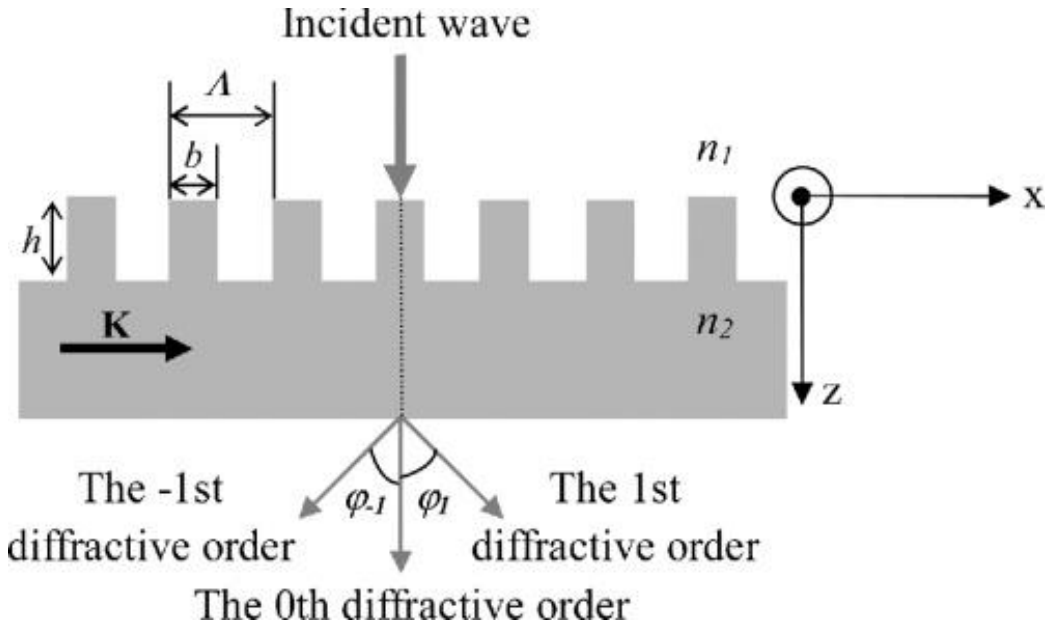


Motivation: Phase-grating

- Why a phase-grating?



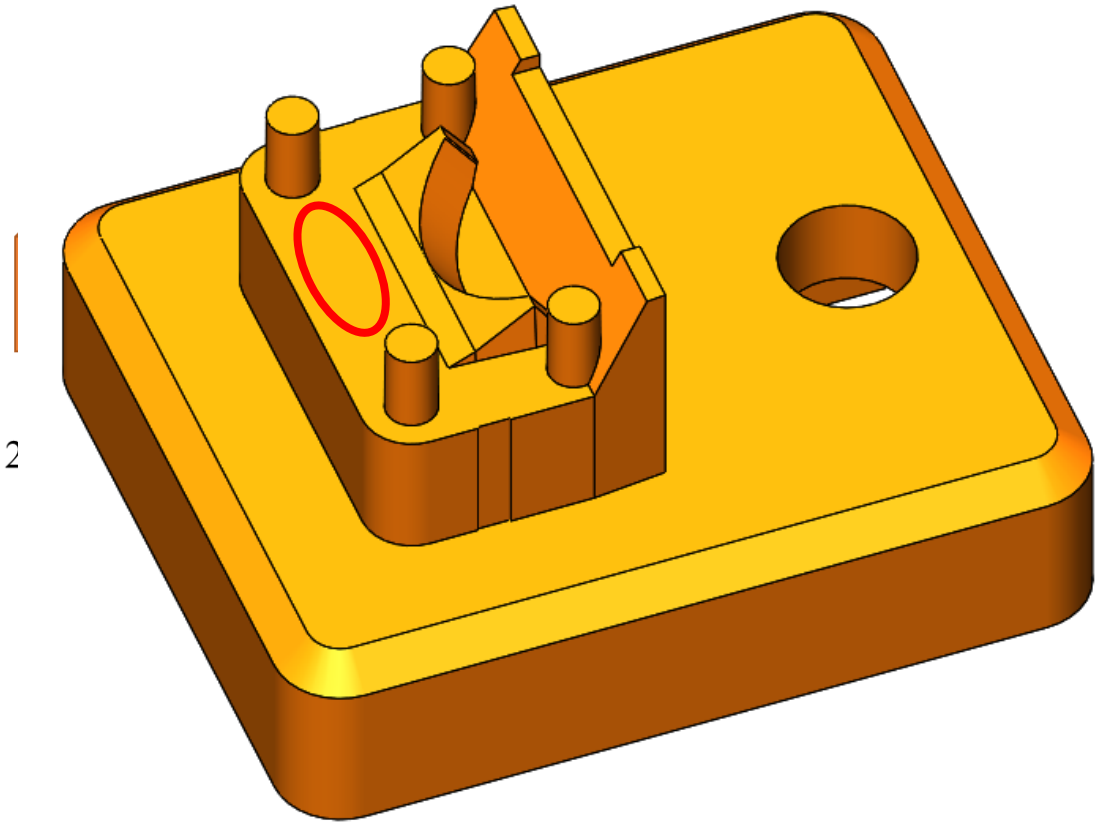
Adapted from Szwaykovsky and Arrizon, 1993.



Feng et al., 1993.

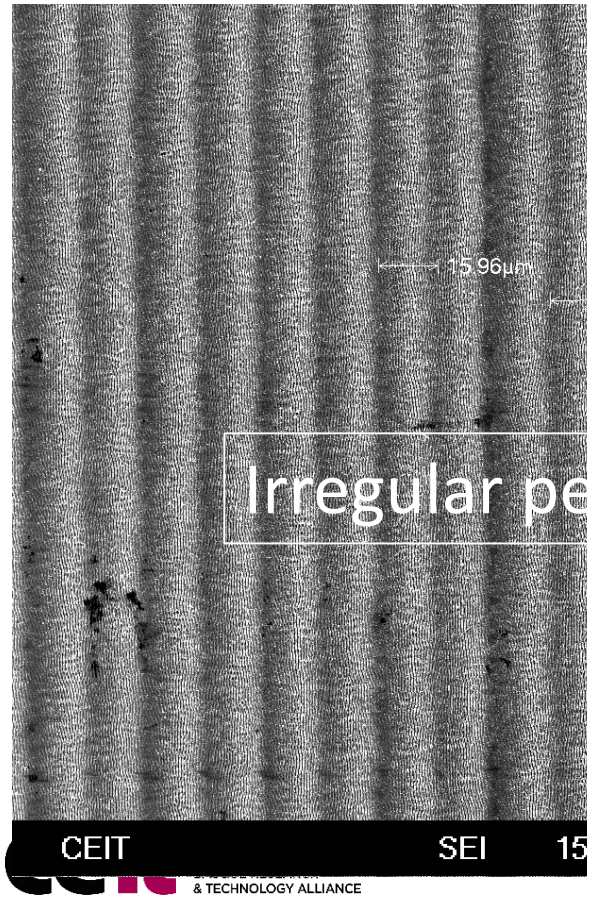
Fabrication of surface-relief phase-gratings

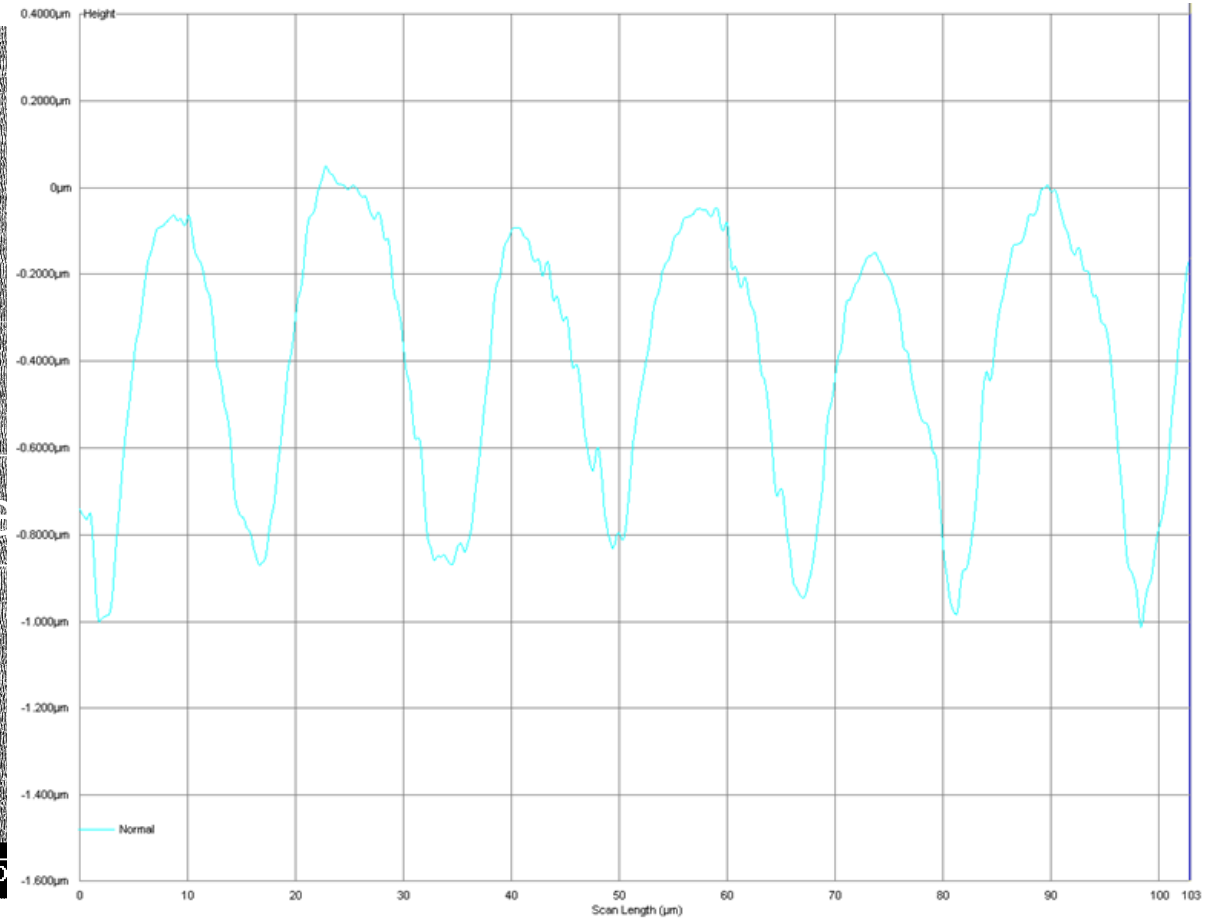
- Parameters of the phase-grating: 7x3 mm, 10 μm period, initially 850 nm depth (afterwards modified).

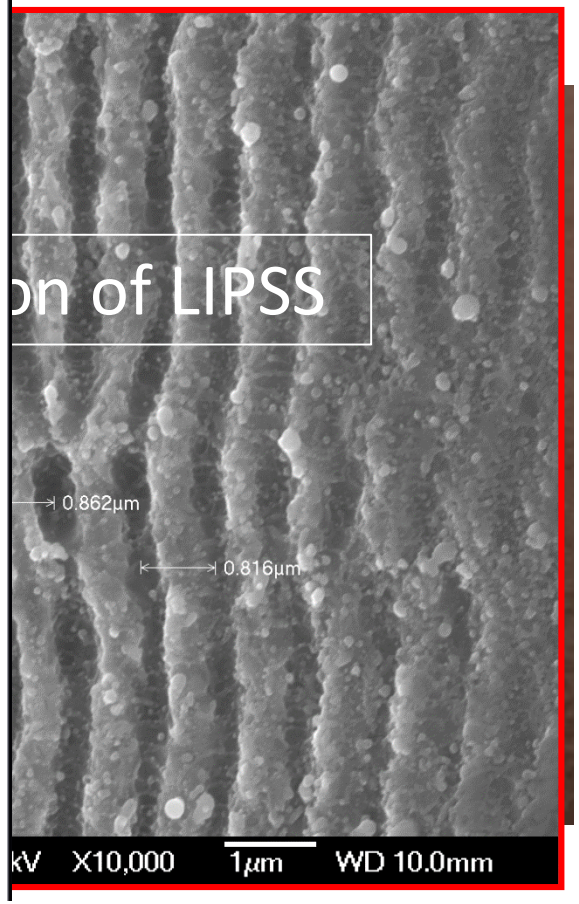


Fabrication of surface-relief phase-gratings

- Smallest achievable period: 16.1 µm -> First samples with a bigger period as a first approach.

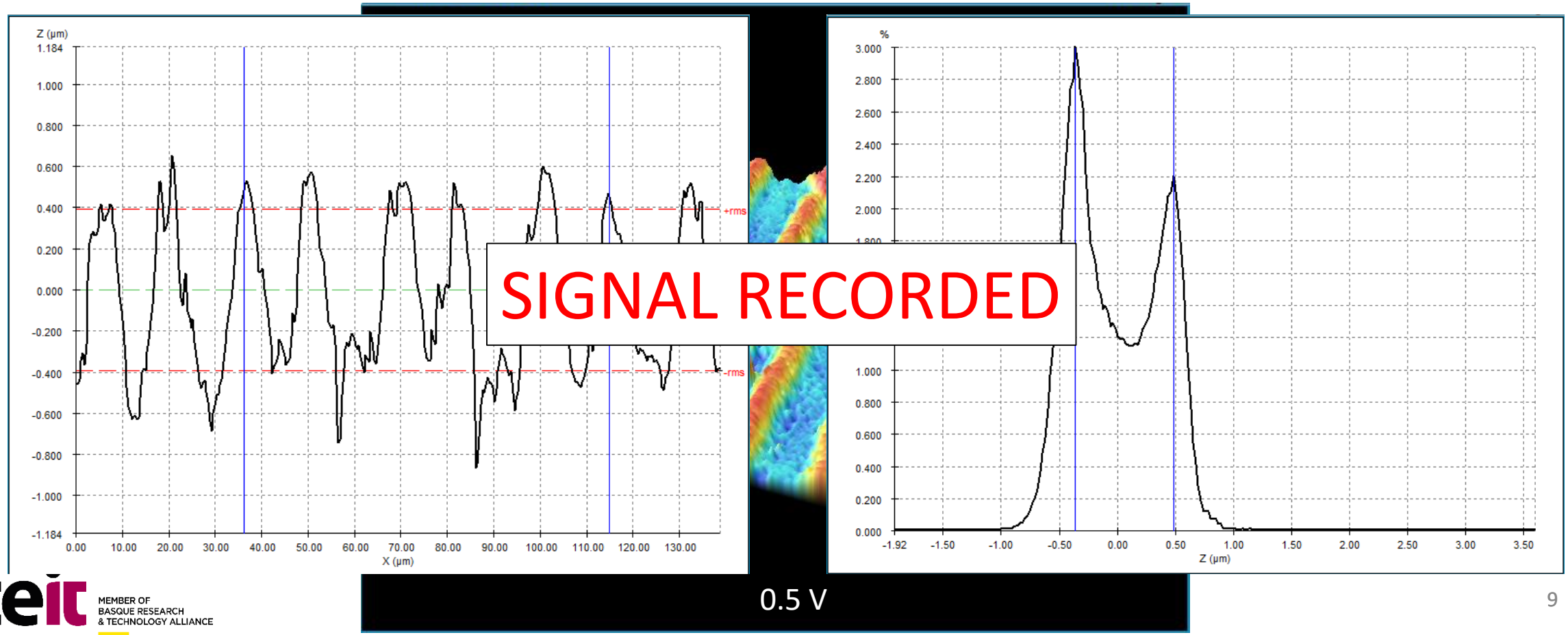






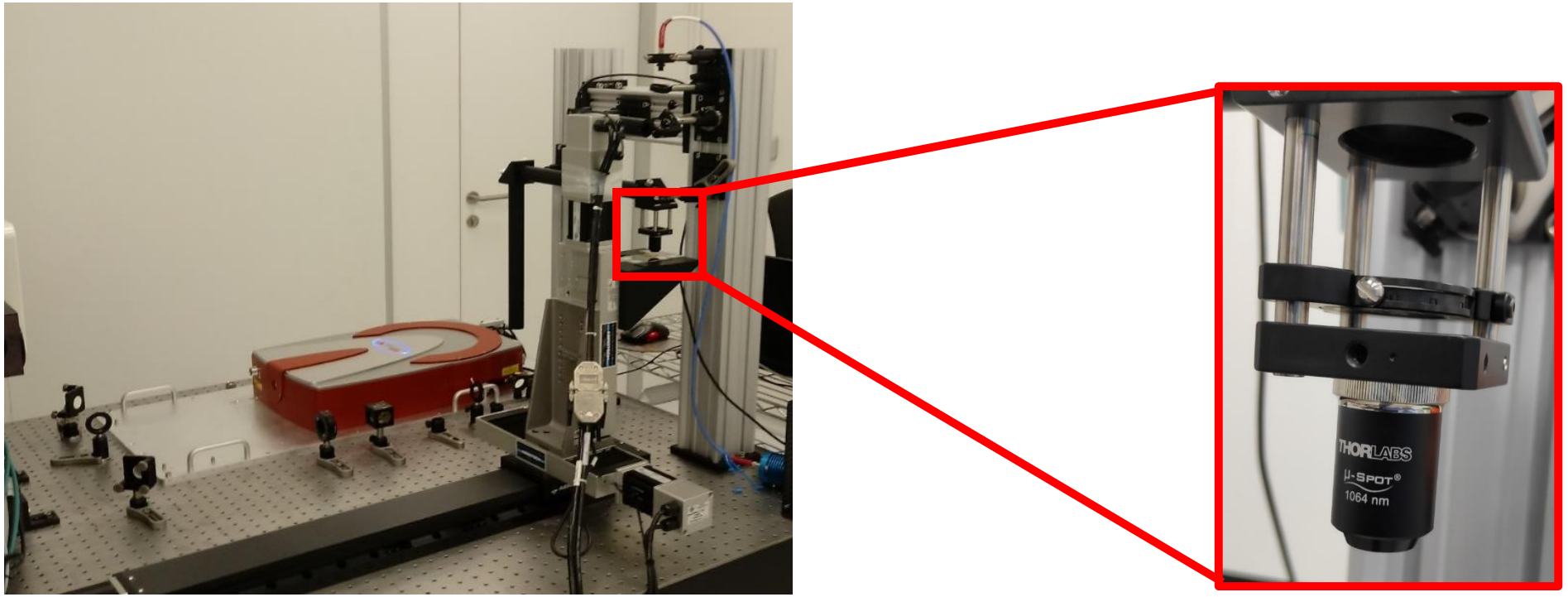
Fabrication of surface-relief phase-gratings

- Injection performed by Promolding in a standard injection moulding machine: melt 300ºC and mould 90ºC
-
-



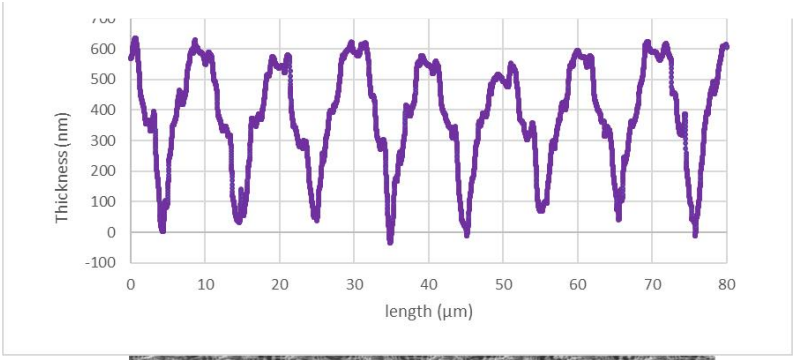
Fabrication of surface-relief phase-gratings

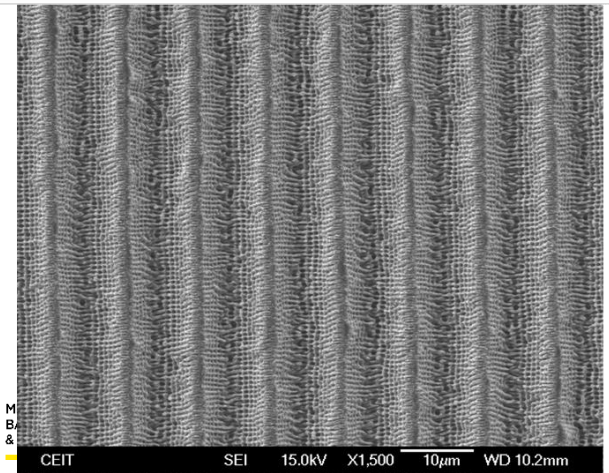
- We needed to find a way to generate a grating with a lower period: second setup.

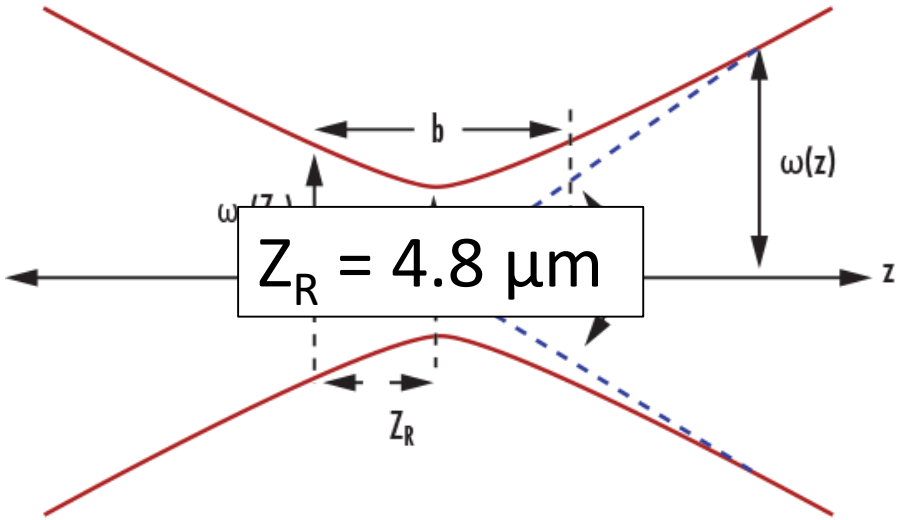


Fabrication of surface-relief phase-gratings

- Two main problems:







Edmund Optics

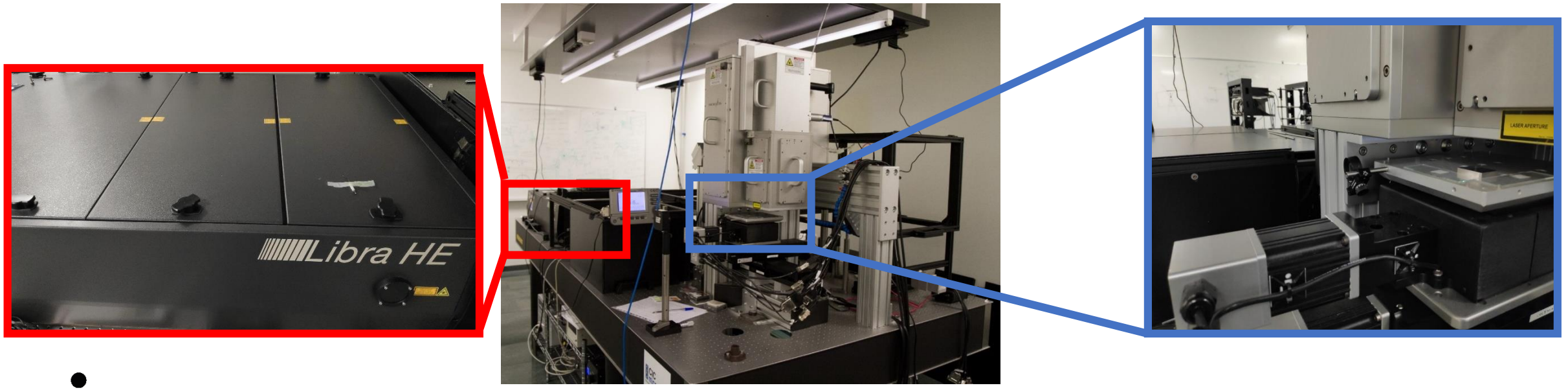
Spot radius

$$Z_R = \frac{\pi w_0^2}{\lambda}$$

wavelength

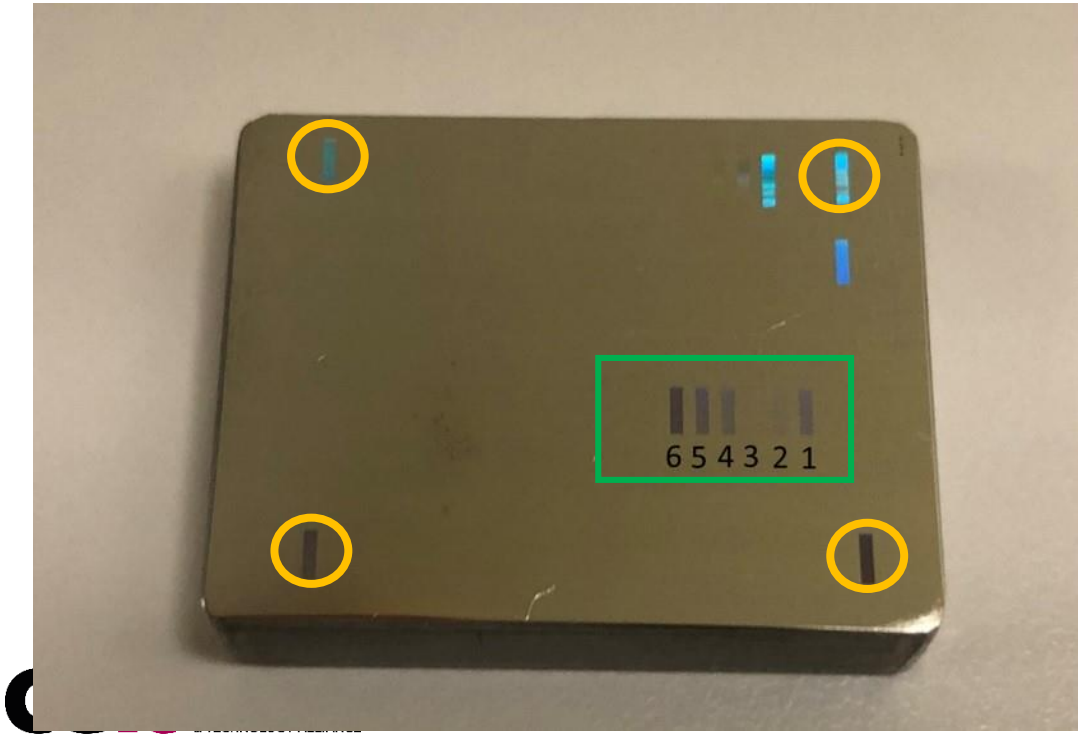
Fabrication of surface-relief phase-gratings

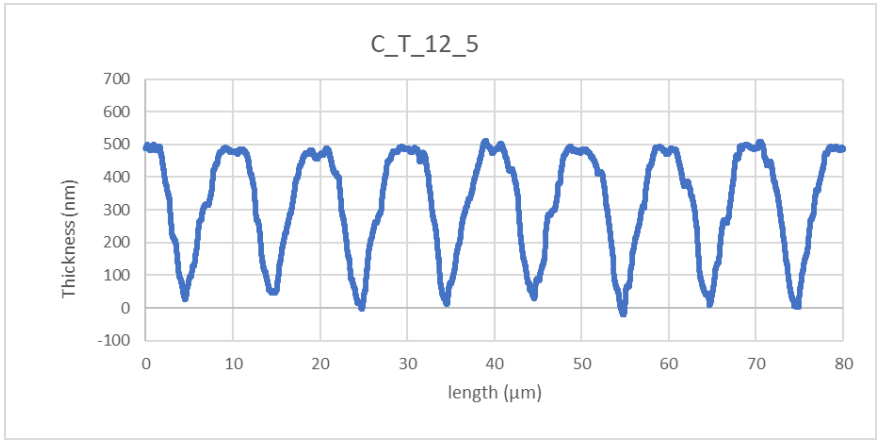
- Third setup:



Fabrication of surface-relief phase-gratings

- First step: Assess surface irregularity and process robustness:

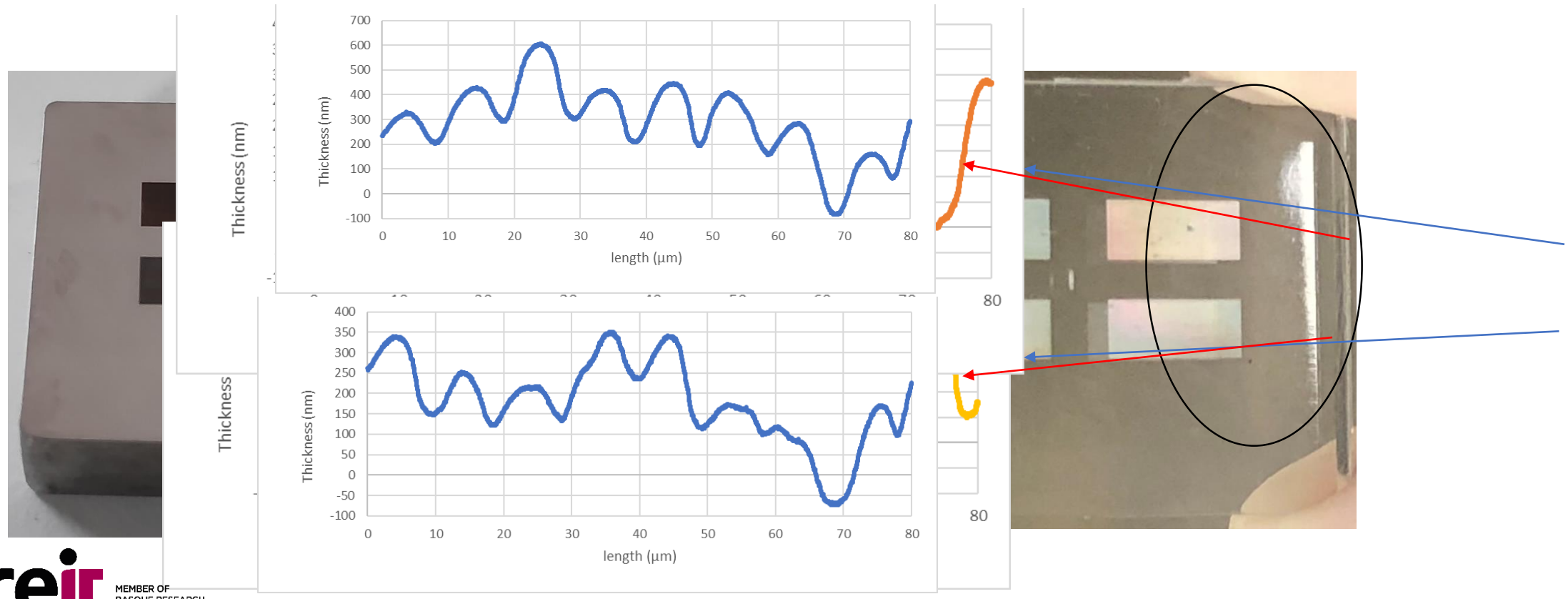




Results are repetitive

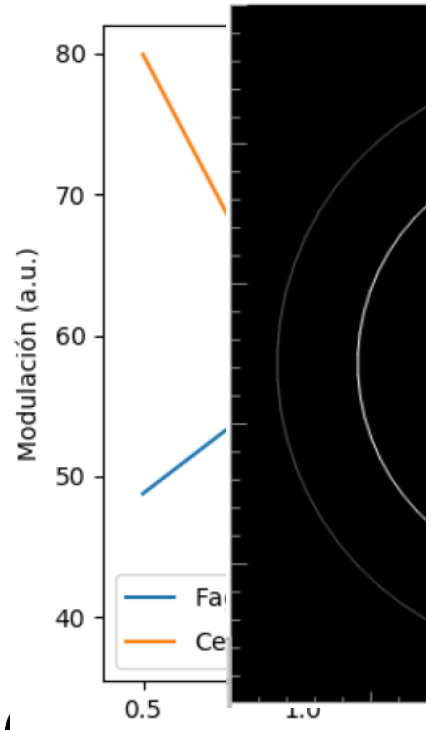
Fabrication of surface-relief phase-gratings

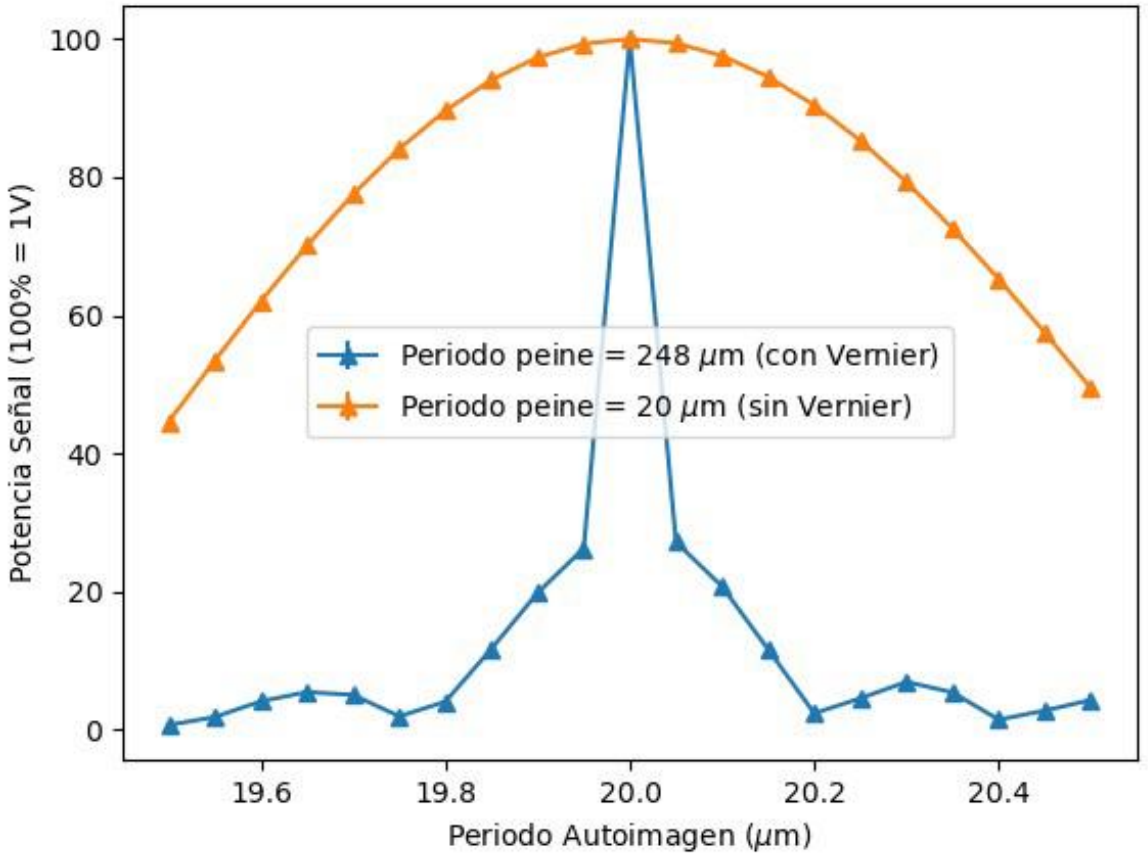
- Four gratings inscribed on an insert with slightly different depths and profiles.



Fabrication of surface-relief phase-gratings

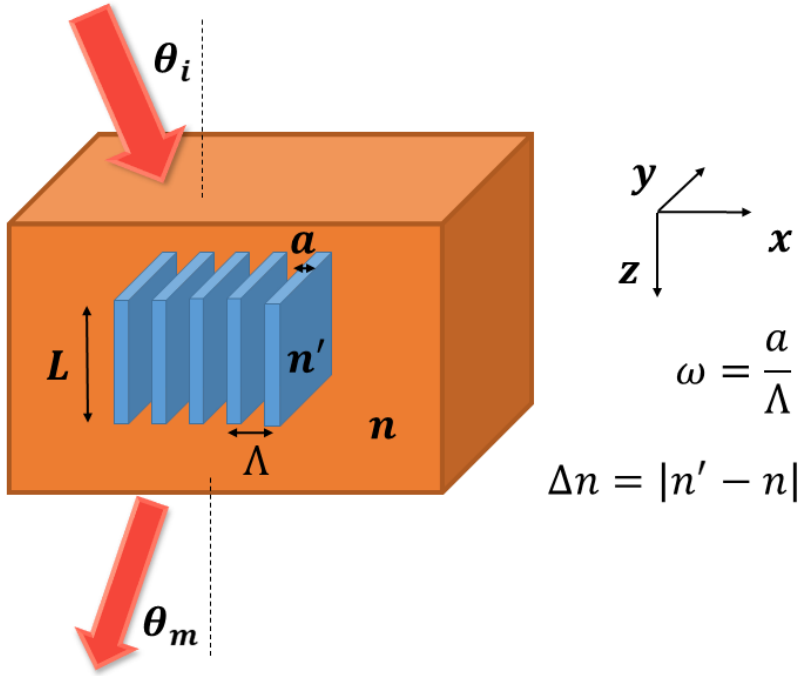
- Functional chara





Fabrication of volume phase-gratings

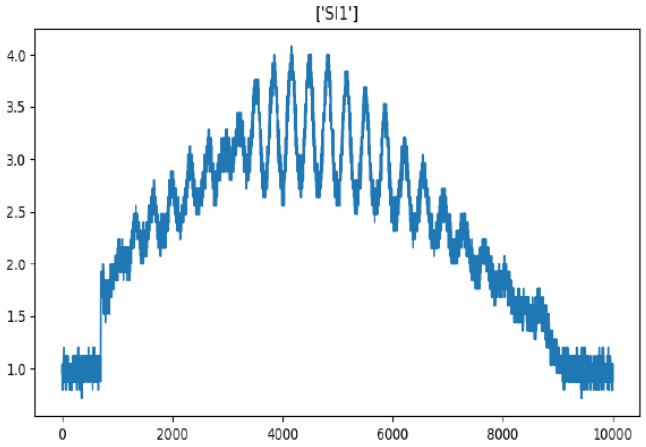
- Alternative: Including a glass grating and co-inject it with the optical head (or glue it later).
- Second setup (20X magnification objective, Amplitude laser).
- Material: Borosilicate glass doped with a 1% of embedded CdSxSe1-x semiconductor nanocrystals of 3.9 nm radii (OG530 Schott Glass Inc.)

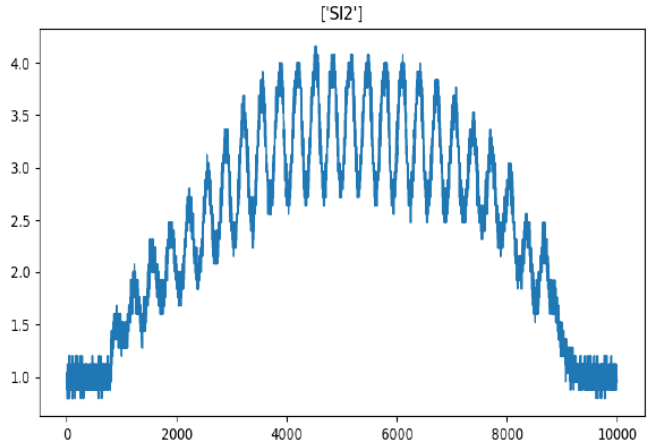


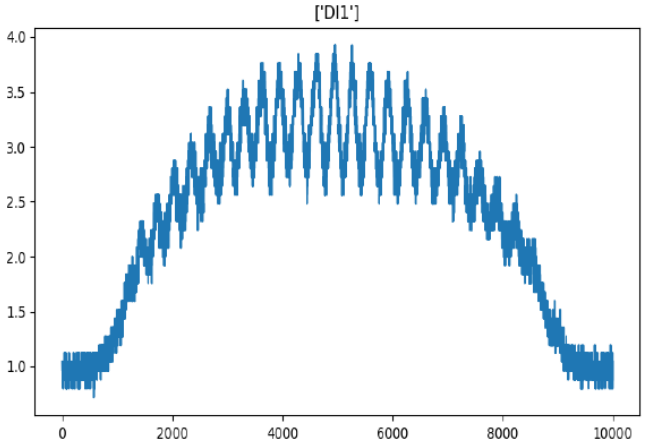
A scheme of the Volume Phase-Grating. The definitions of the parameters of interest are shown.

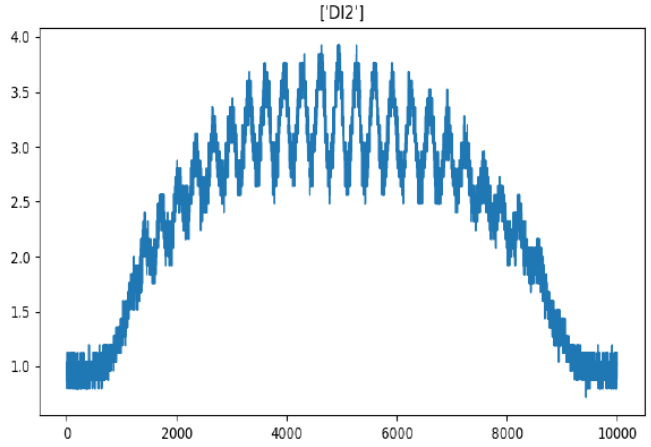
Fabrication of volume phase-gratings

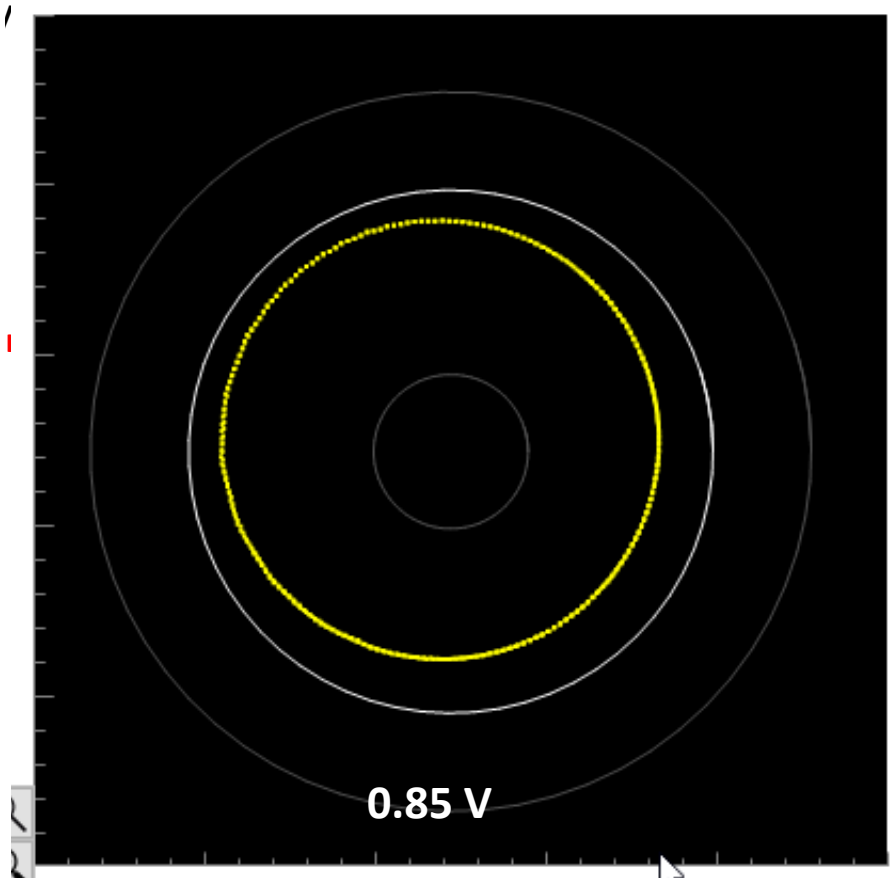
- Functional characterisation by Fagor:











Conclusions

Thanks for your attention

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FLOIM

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Factories of the Future Public Private Partnership

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820661
The FLOIM project is an initiative of the Factories of the Future Public Private Partnership