Deposition and self-alignment of CdSe nanorods on defects of a layer of liquid crystal

Pelliser Laurent

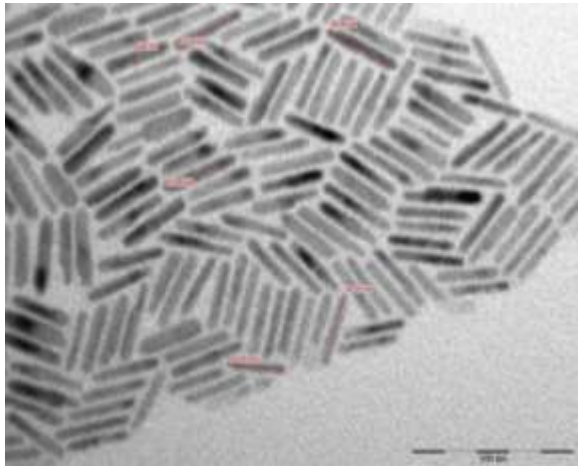
Institut des NanoSciences de Paris

Objectives

- Production of the desired liquid crystal structures
- Observation and analysis of the nanorods properties once deposited on the LC
  - Light polarization
  - Self-alignment
  - LC influence on the nanorod properties

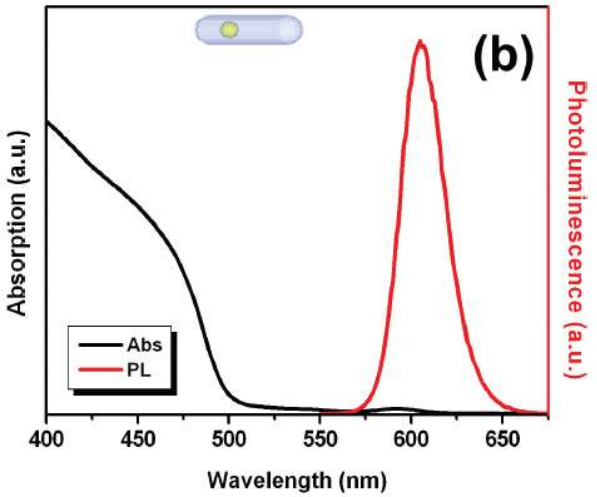
CdSe/CdS nanorods

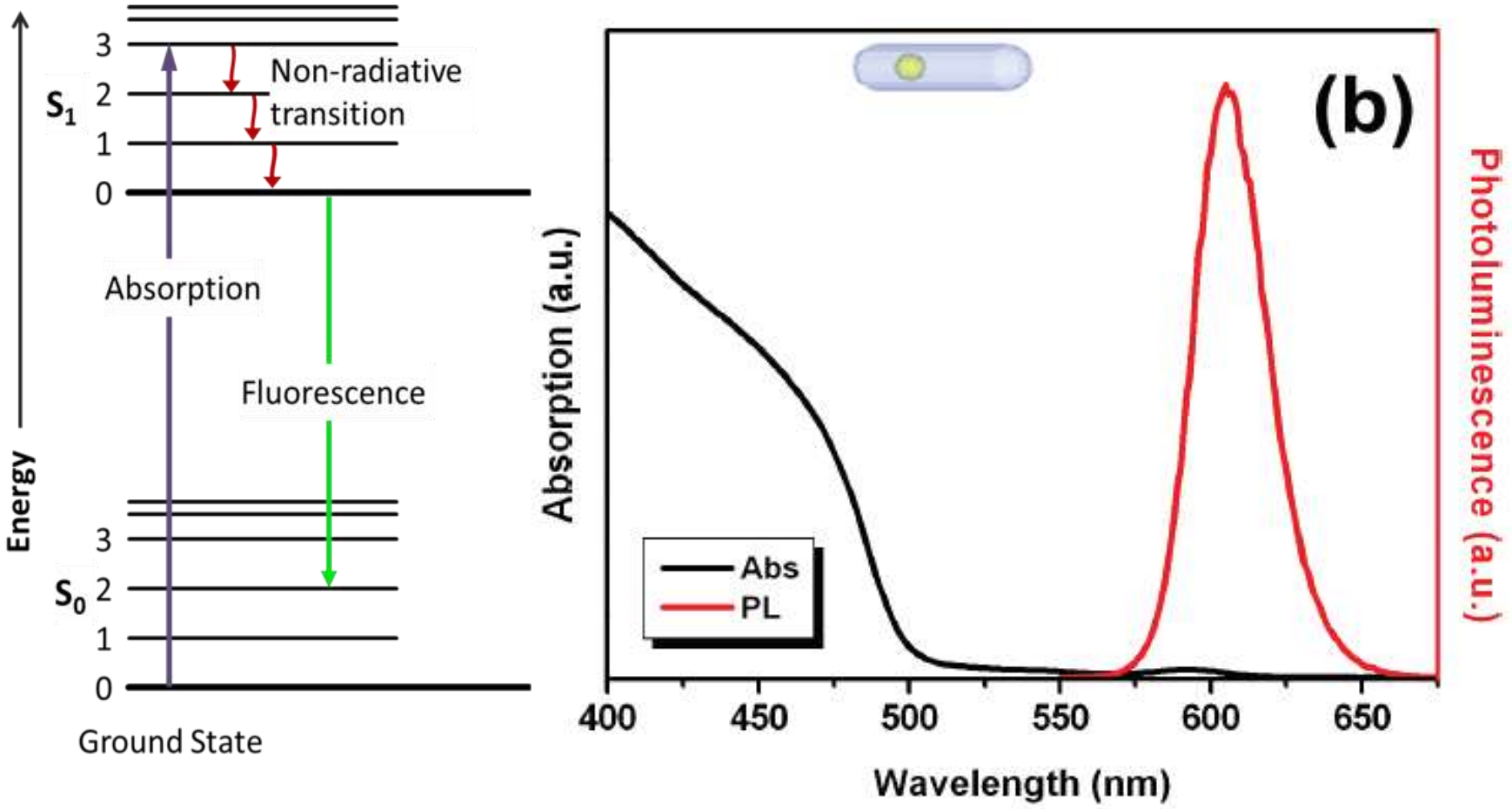
- Core/Shell structuration
- Dimensions :
  - Length 22 nm
  - Core diameter 2,9 nm
  - Shell thickness 4 nm



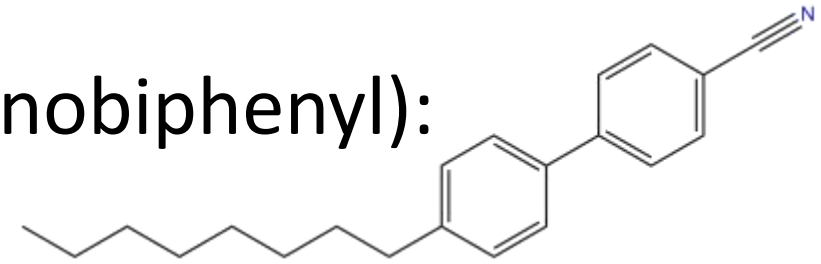
De Vittorio *et al.*, Lecce, Italy

- Fluorescence phenomena:
  - $\lambda_{emission}$: 610 nm




Energy
S_1
3
2
1
0
Non-radiative
transition
Absorption
Fluorescence
S_0
3
2
1
0
Ground State
(b)
Absorption (a.u.)
Photoluminescence (a.u.)
Abs
PL
400
450
500
550
600
650
Wavelength (nm)

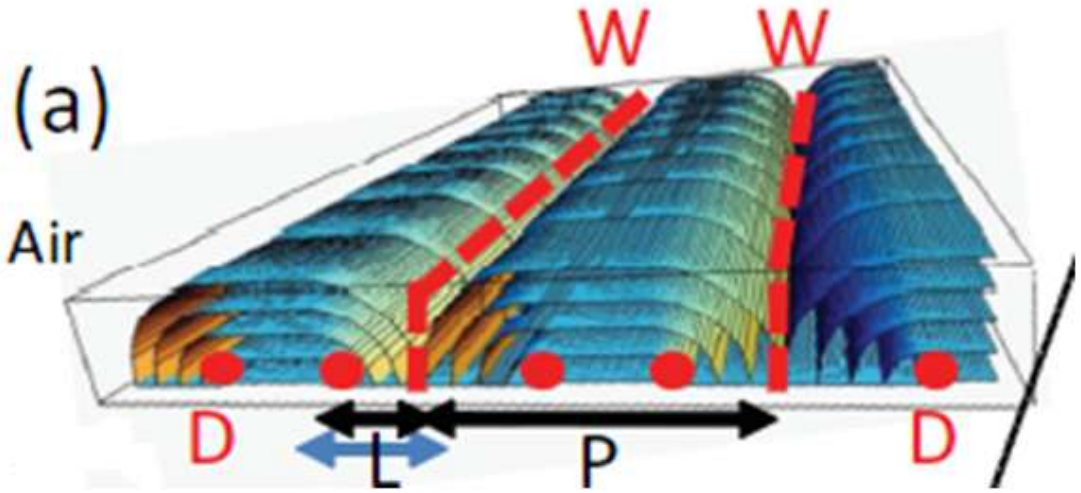
- 8CB (4-octyl-4'-cyanobiphenyl):



  - Liquid crystal

  - Smectic A

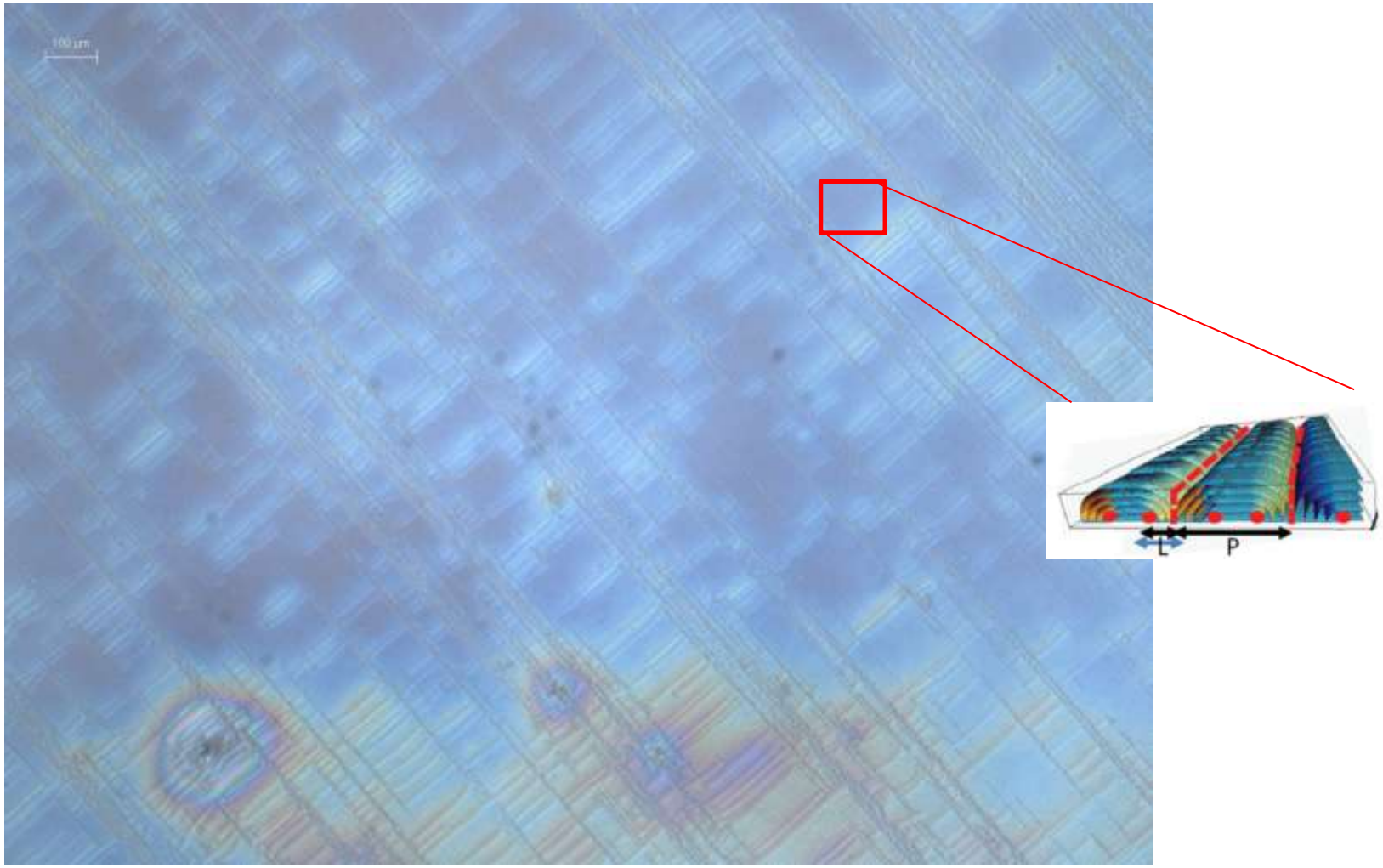
- Deposition on an anisotropic substrate



- Self-organization of the LC in hemicylindric structures
- Two types of energy-consuming defects

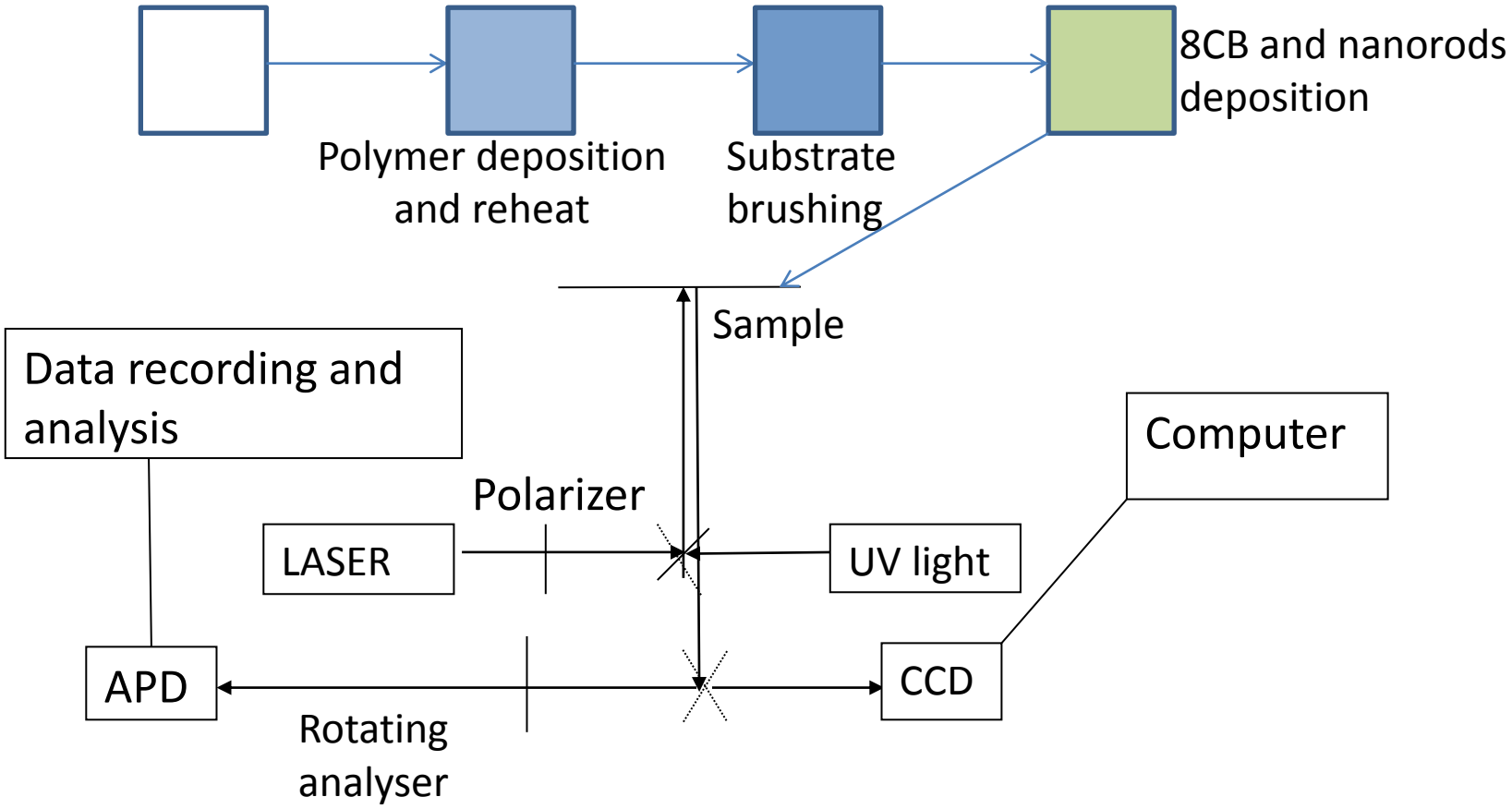
- Hypothesis: nanorods settling in the defects (total energy consumption reduced)
- Objective: have the nanorods turned in a specific direction alongside the defects
- Long-term objective: manufacture long chains of aligned nanorods

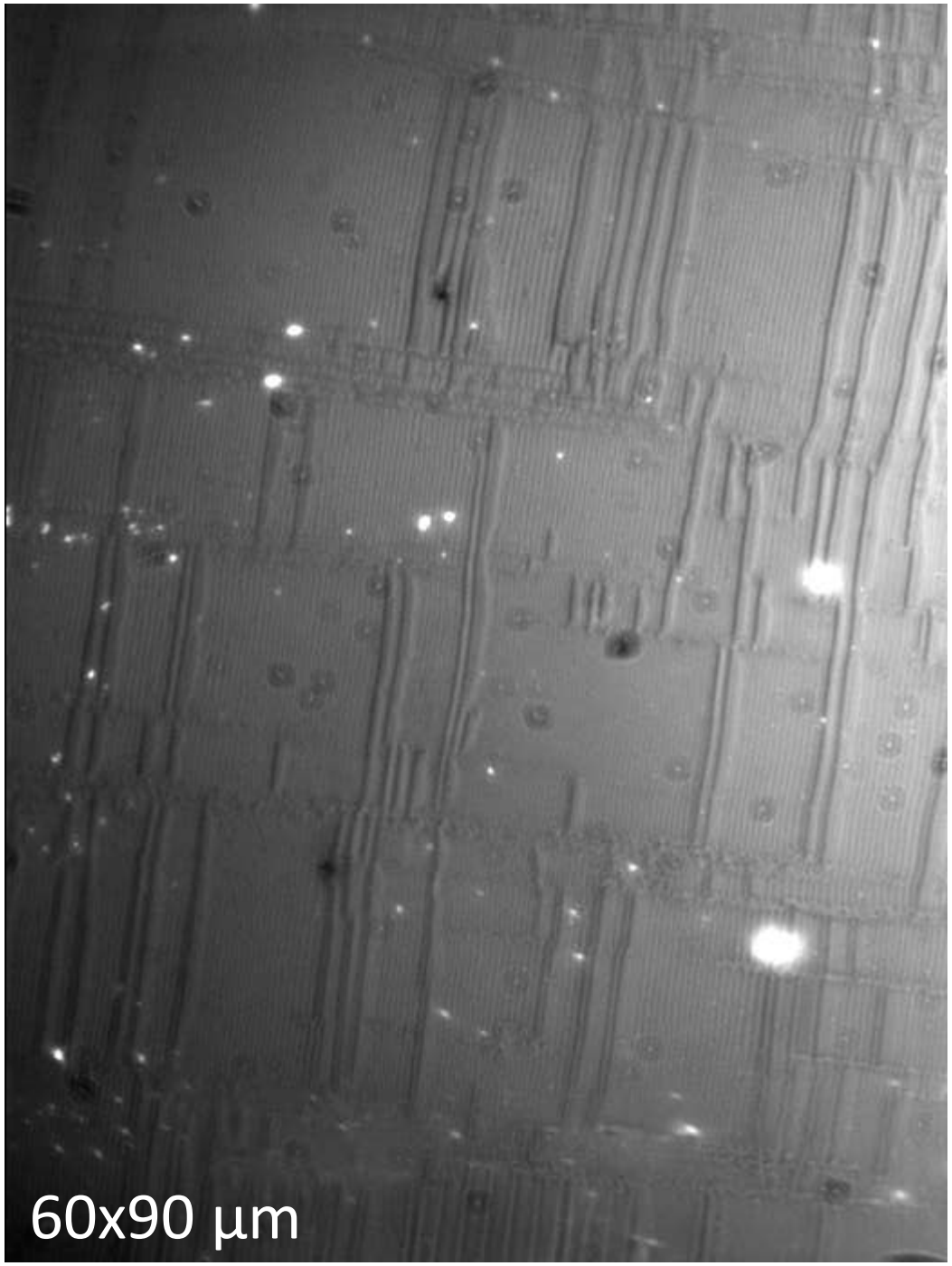
- Liquid crystal thickness control over large areas (optical microscopy):



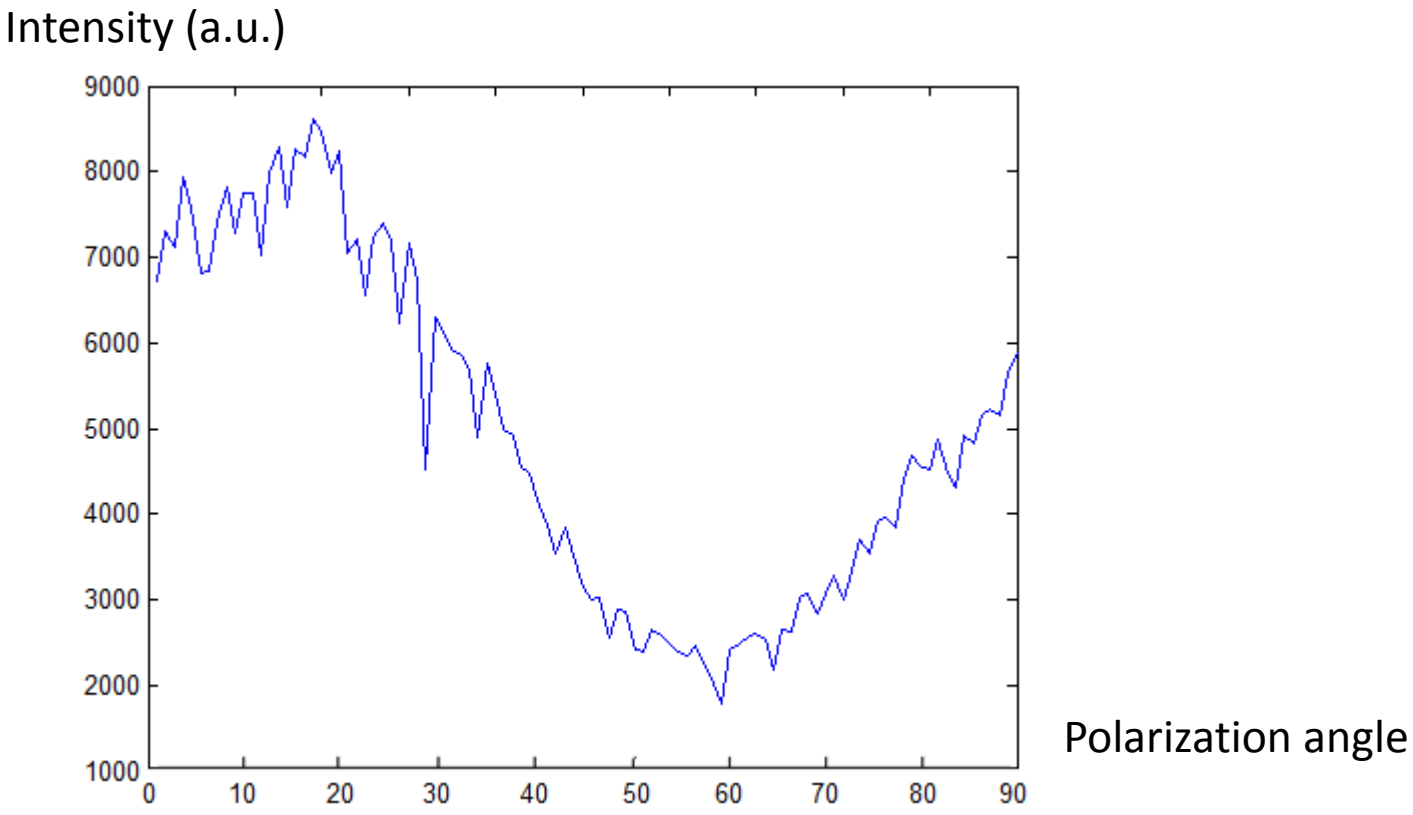
Nanorods

- Experimentation done in collaboration with Alberto Bramati's team (LKB)




60x90 µm

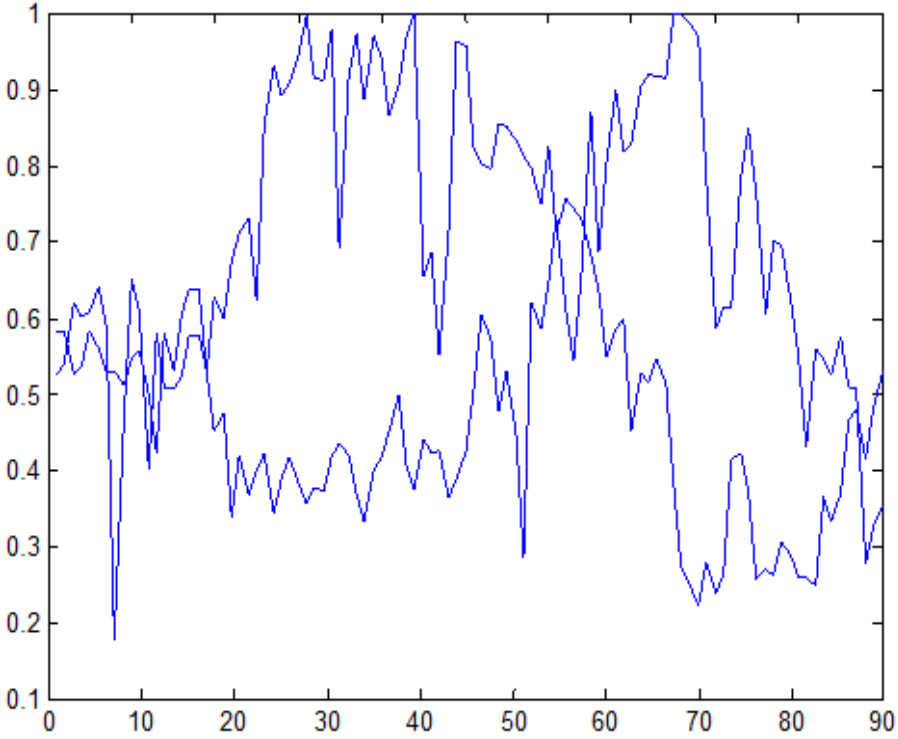
- Polarization measurement



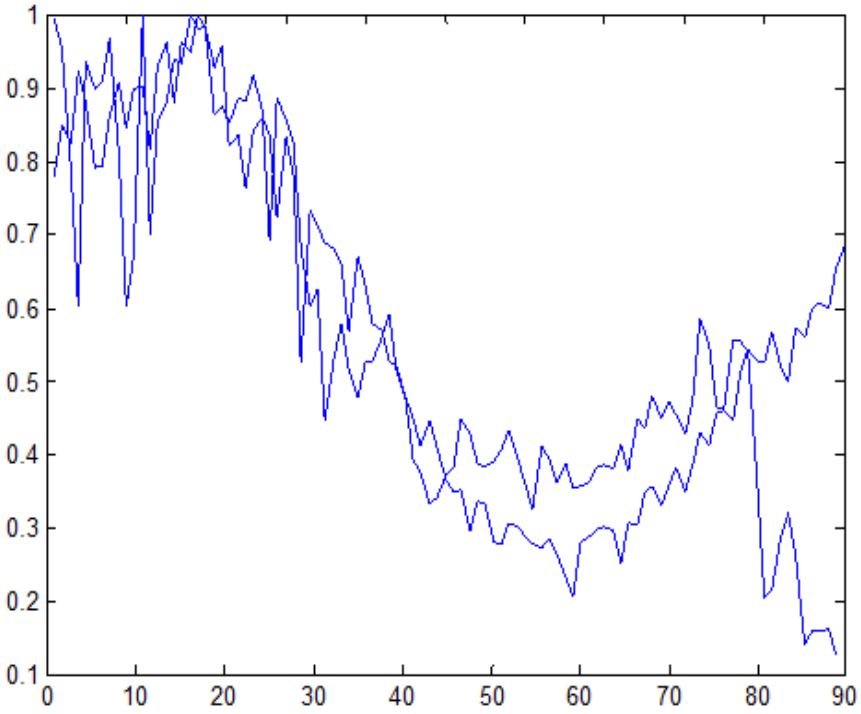
-> Polarization of reemited light confirmed

- Comparison of the polarization data for two nanorods

Unbrushed area



Brushed area



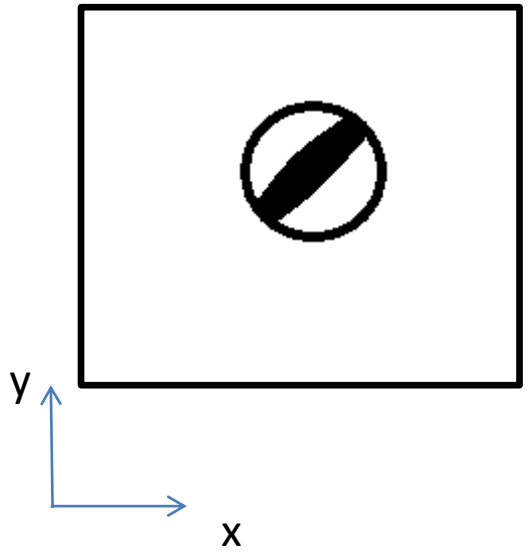
-> Nanorod orientation

Observations

- Polarization of the light emitted by the nanorods
- Similar orientation of all the nanorods deposited on the structured LC, regardless of proximity
- Random orientation of the nanorods deposited on the non-structured LC

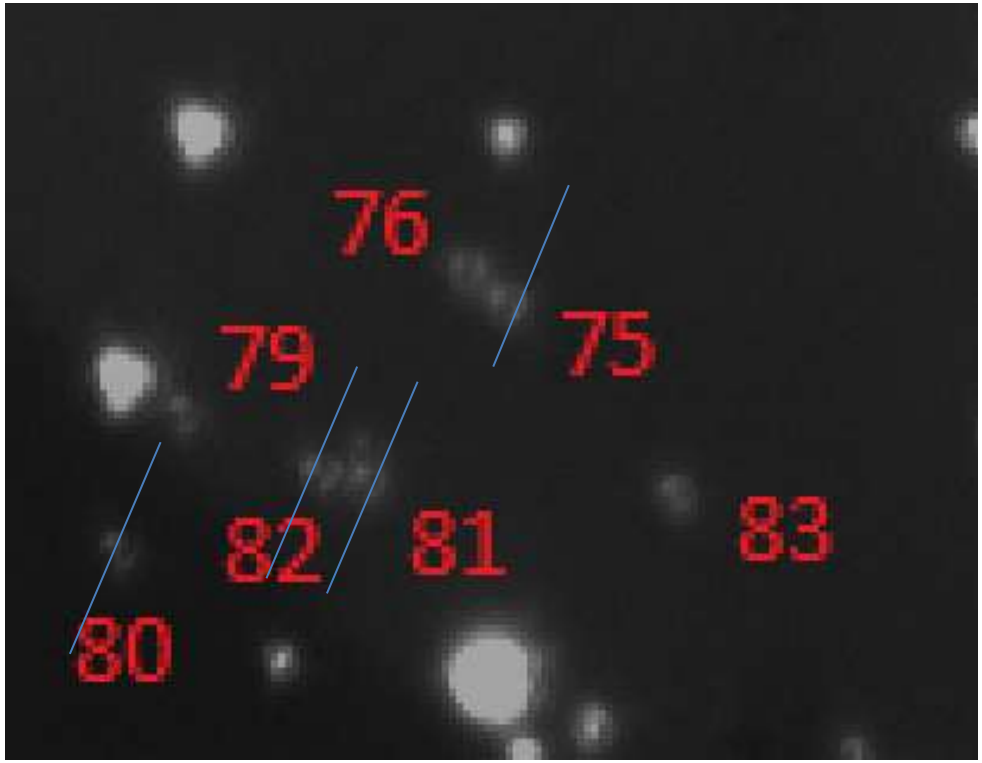
Defocalisation

- Interface with LC and with air:
  - Non-standard dipolar emission from the nanorods
  - Dark area at the vertical of the substrate.



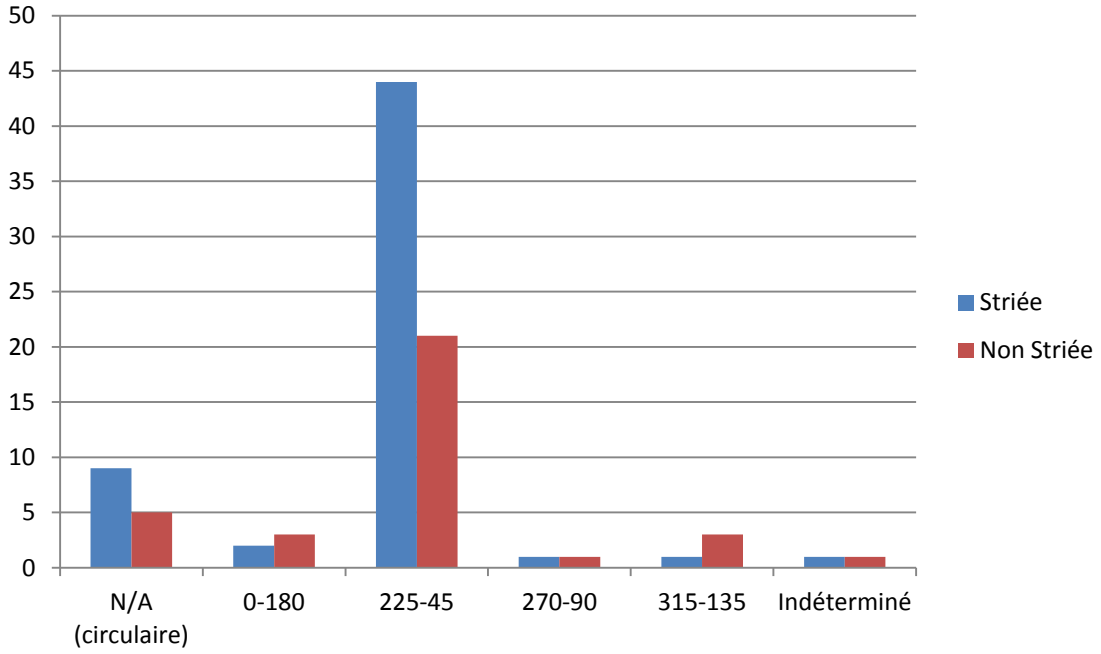
- Statistical analysis of nanorods orientation

-> Along the liquid crystal defects



F. Pisanello *et al.*, **Room temperature-dipolelike single photon source with a colloidal dot-in-rod**, Applied Physics Letters (2010)

- Analysis results:



- The nanorods are clearly aligned on a single direction, the same as the defects

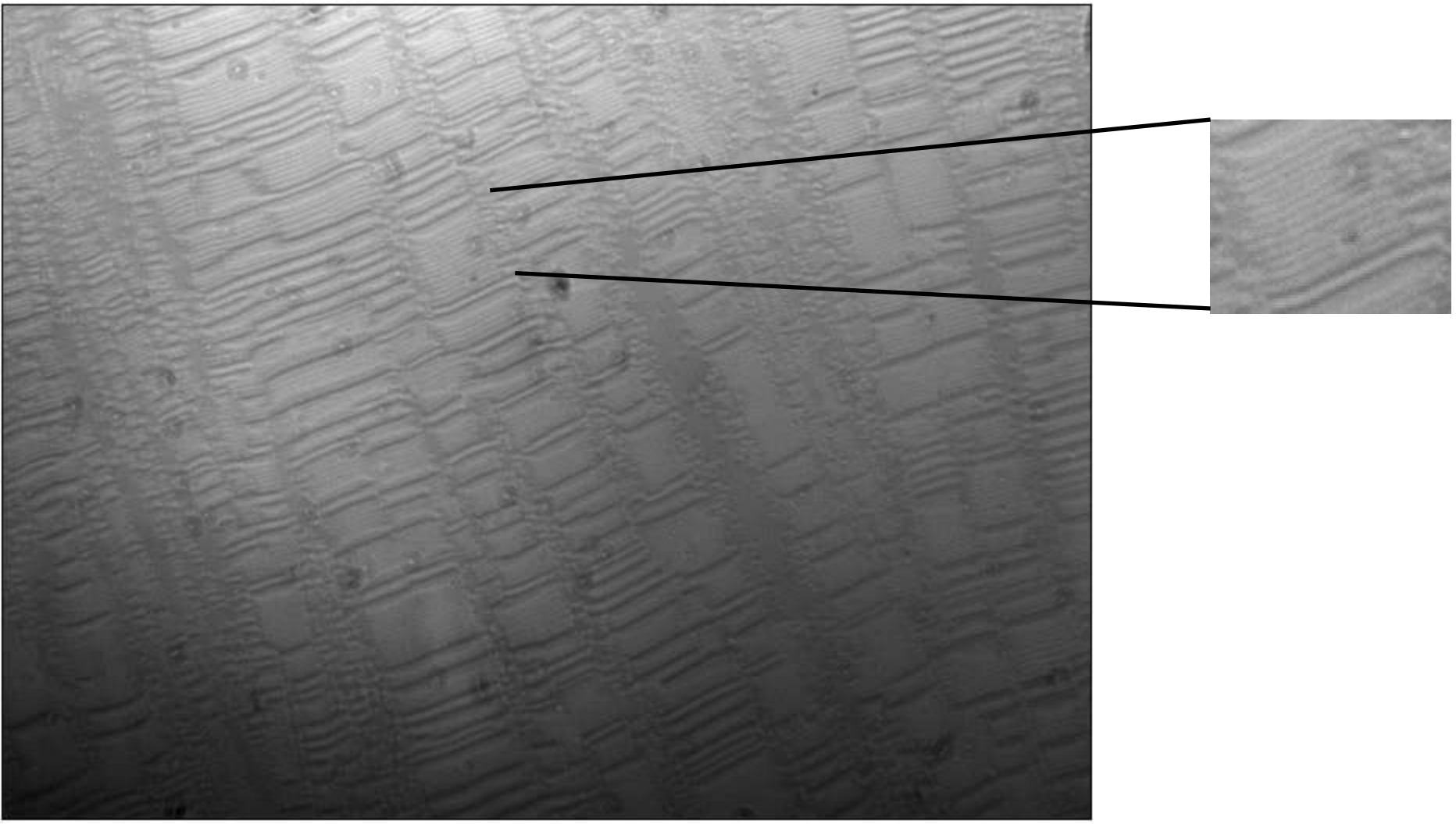
Conclusions

- Polarization of the emitted light observed
- Observation of the liquid crystal structures
- Wide-area self-orientation demonstrated for the nanorods
- Clear data linking the orientation behaviour to the LC thickness

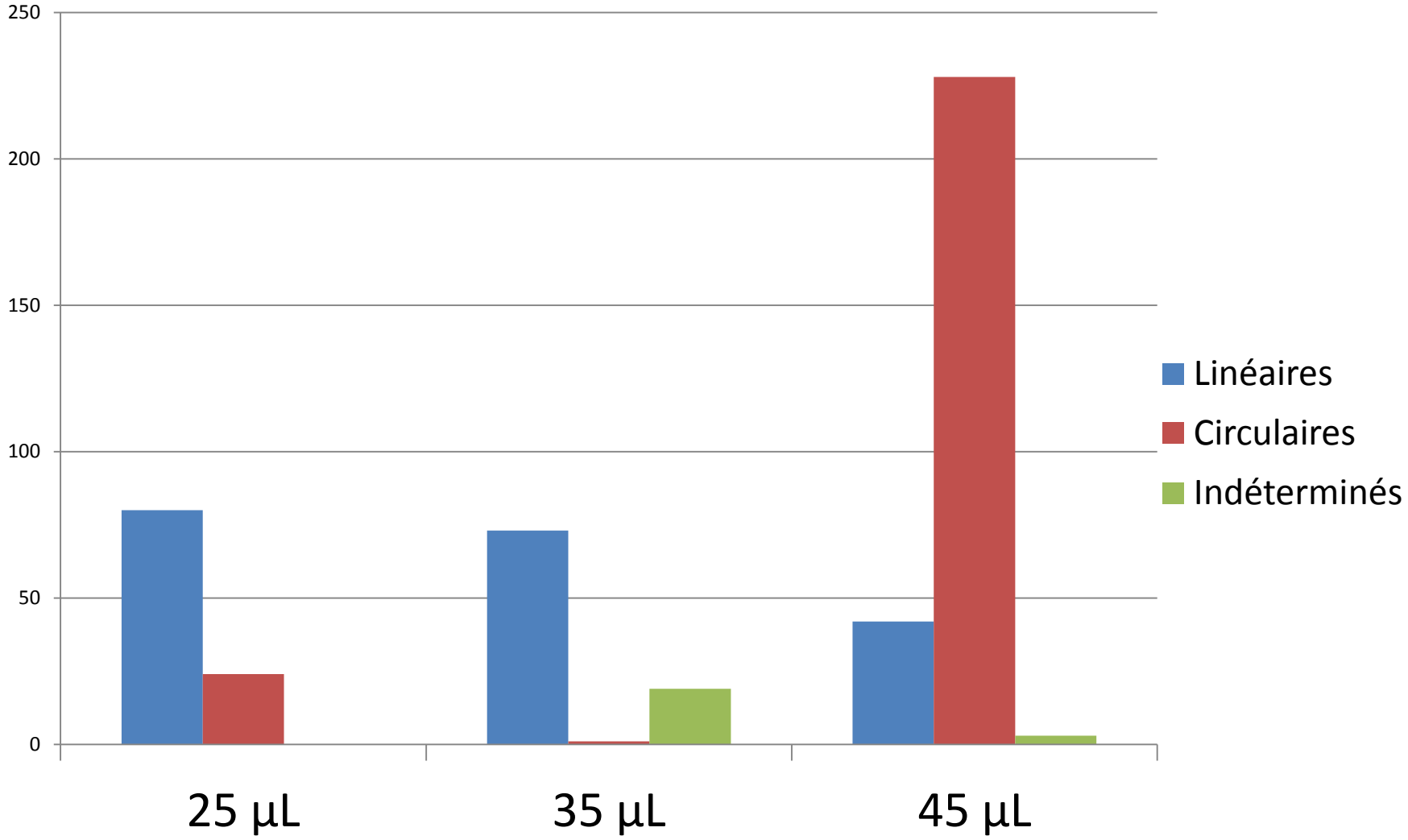
-> Additional experimentation to do with higher NR density and other nanoparticles

Thank you for your attention

35 µL



45 µL



Correlation [LC thinckness]<–>[NR orientation]