Photoinduced Anchoring of Liquid Crystal on Nano - Layers of Chalcogenide Glass Film

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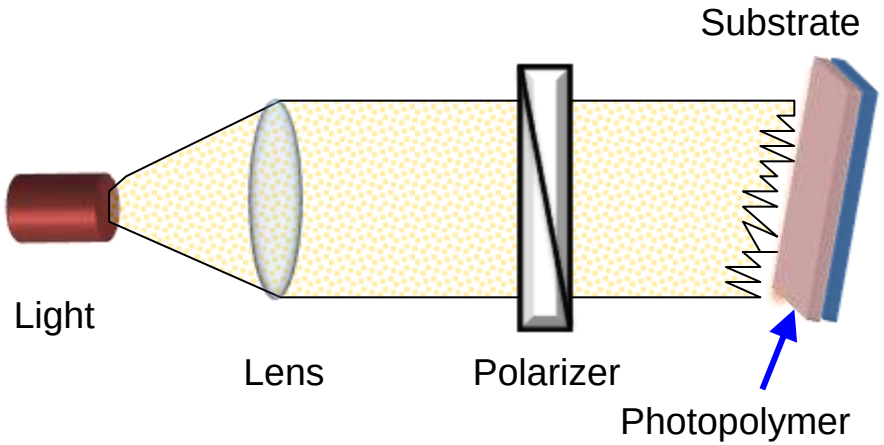
Photoalignment technique [1,2,3]

- Contactless technique → no particles and electrostatic charge
- Can be used for not-accessible and hard-accessible areas
- Complex spatial director pattering can be produced
- Anchoring properties is effectively controlled



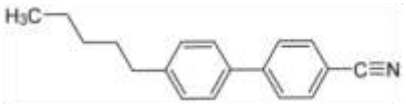
[1] W.M. Gibbons et. al. *Nature* **351**, 49 (1991).
[2] A. Dyadyusha, et. al. *Ukr. Fiz. Zh*, **36,** 1059 (1991)
[3] M. Schadt et al. *Jpn. J. Appl. Phys.* **31**, 2155 (1992).

Materials:

Liquid crystals:

✓ **5 CB** T_c=36° C

✓ ***E44*** T_c=100° C

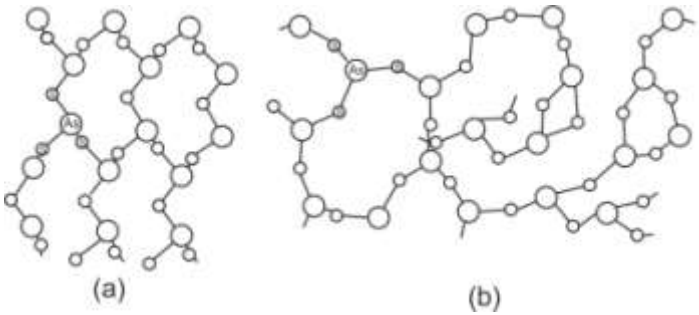


Chalcogenide glass films:

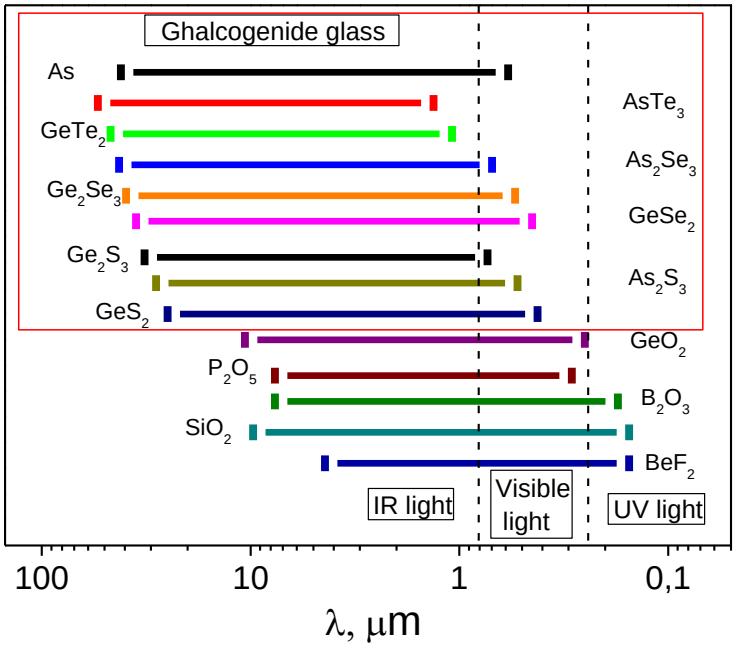
✓ **As_2S_3 (d=20 nm)**

✓ **$As_{20}Se_{80}$ (d=200 nm)**

Glasses containing one or more chalcogenide elements (S, Se, Te, Po) of 16 group are denoted as **chalcogenide glasses.**

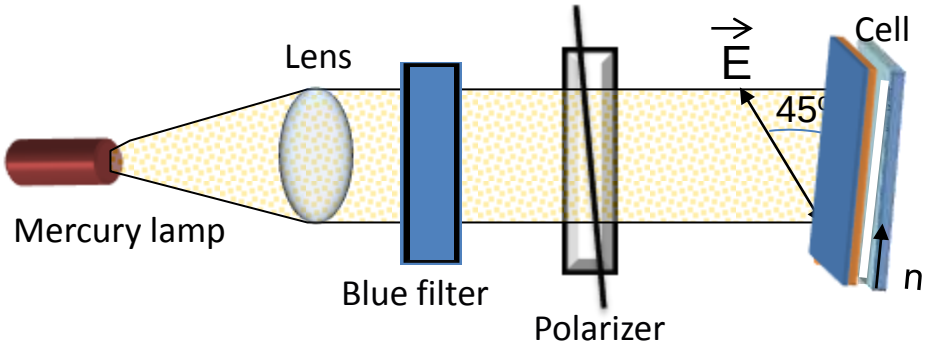


The structures of As_2S_3 (a) – crystalline phase, (b) – glassy phase.

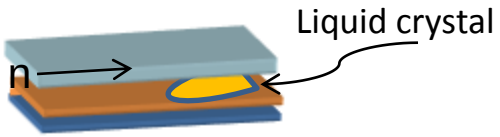


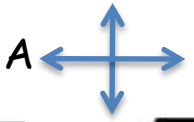
Transmittance bands

Photoalignment of LC in the cell that was irradiation before filling and after



Filling the cells





$\lambda = 436,6nm$

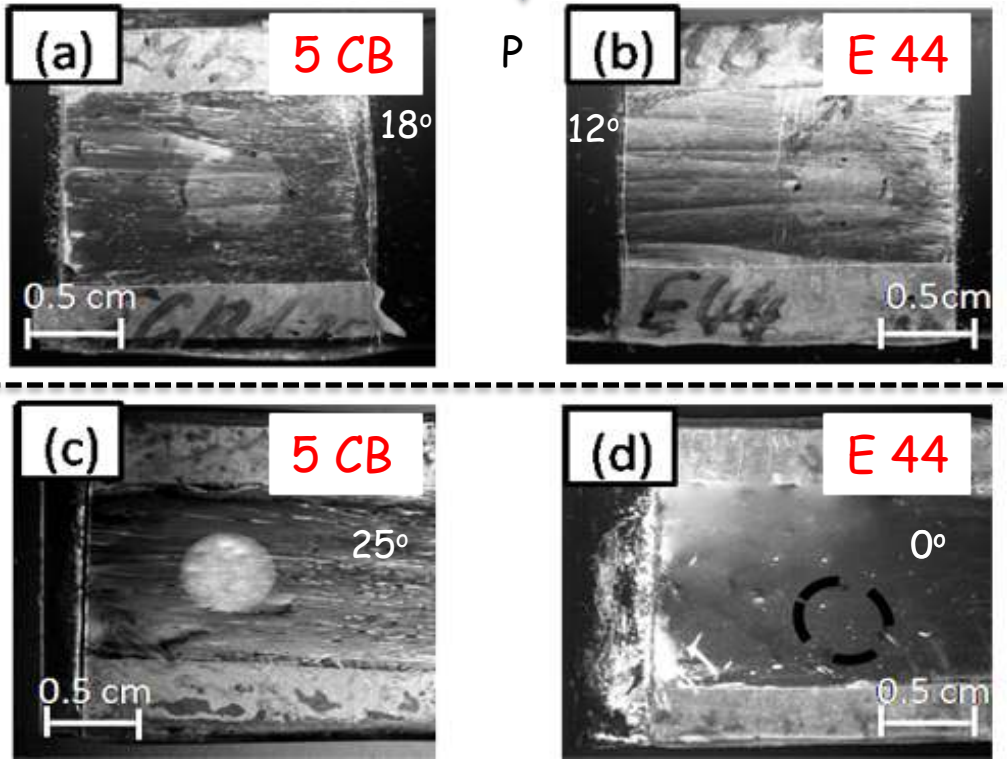
d=20-28µm

As_2S_3 (d=20 nm)

I = 2,2*10^2 W/m^2

T_{exp}= 30 min

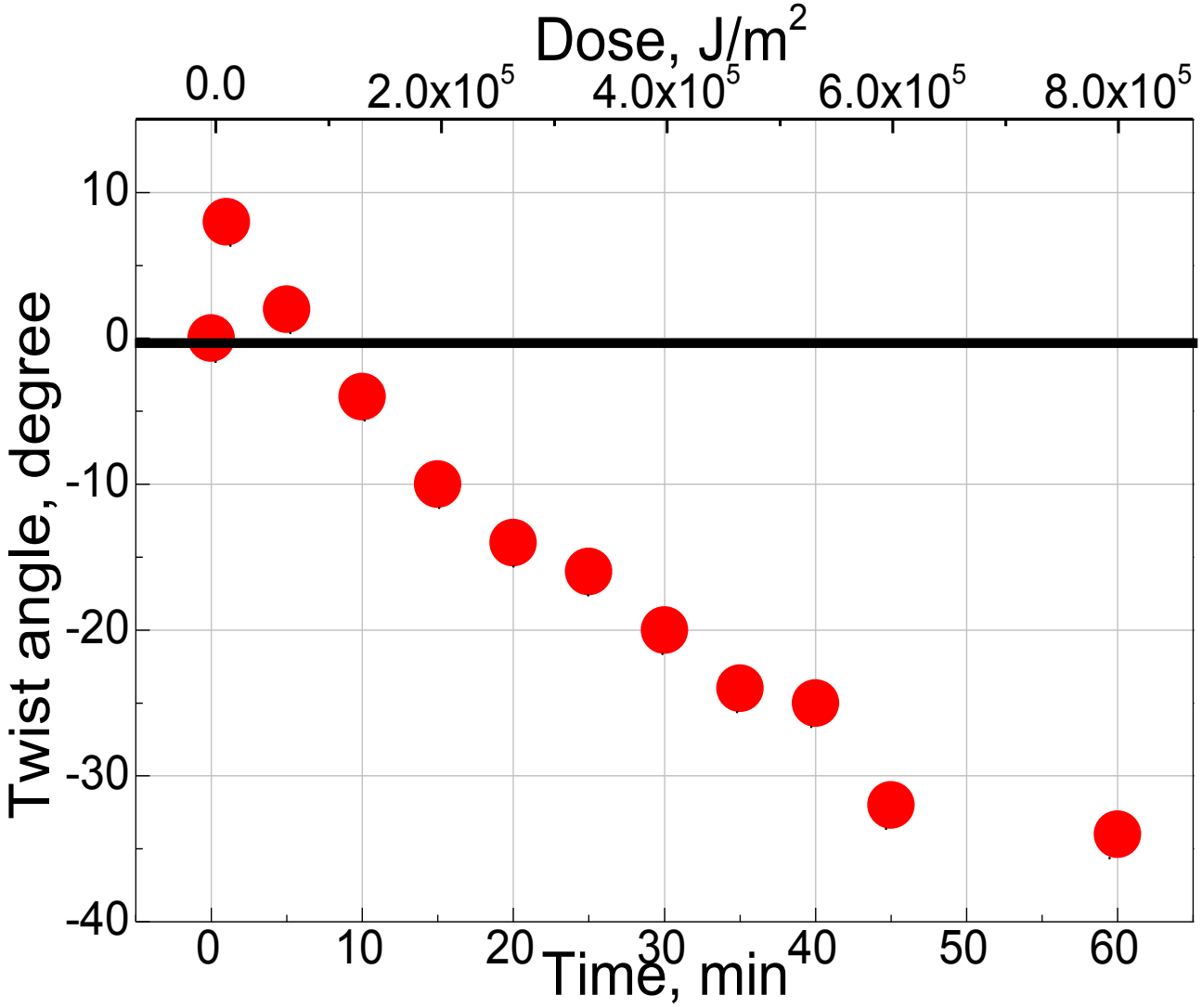
LC: 5 CB,



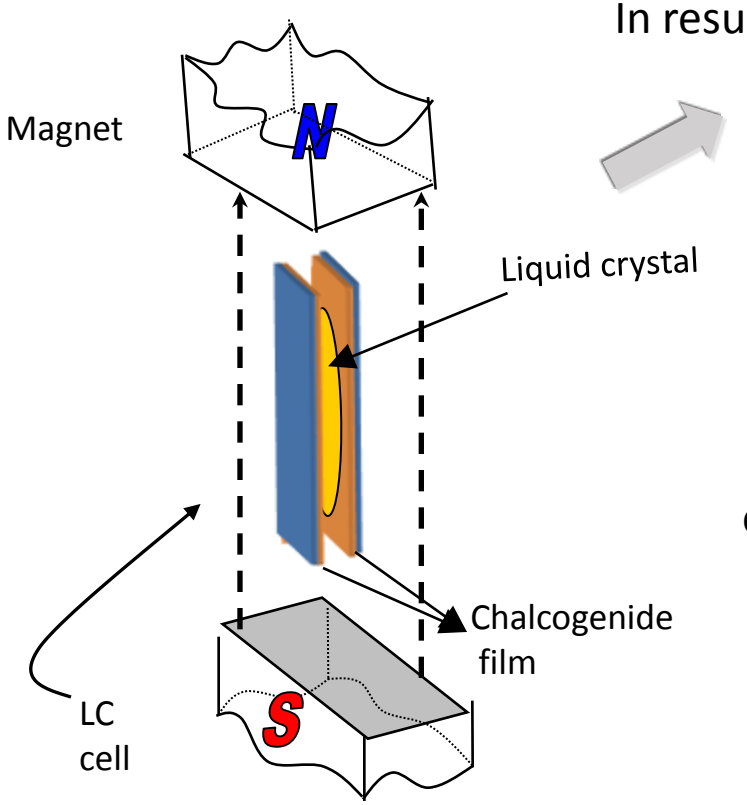
Filling the cell after irradiation

Filling the cell before irradiation

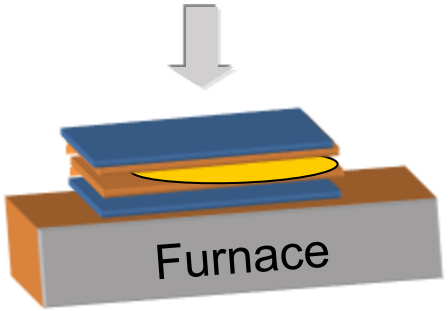
Dependence of the photoinduced twist angle of the LC 5CB on the incident light dose and exposure time.



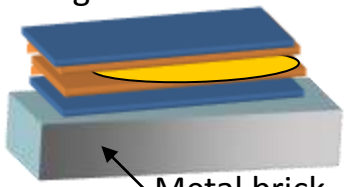
The layer of molecules of LC that adsorbed on chalcogenide glass film

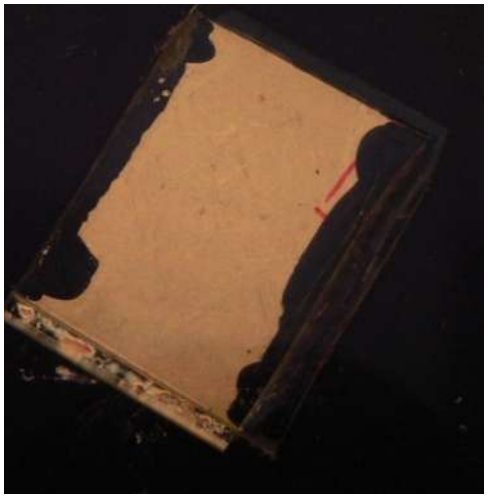


In result we have homogeneous planar alignment



Cooling of the cell

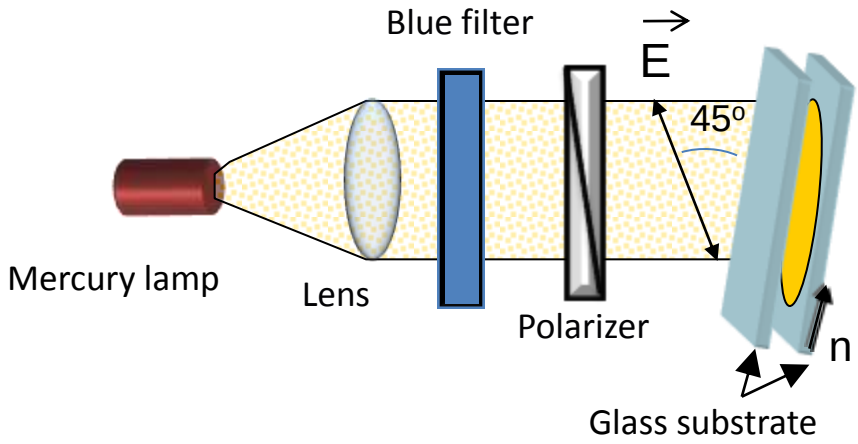


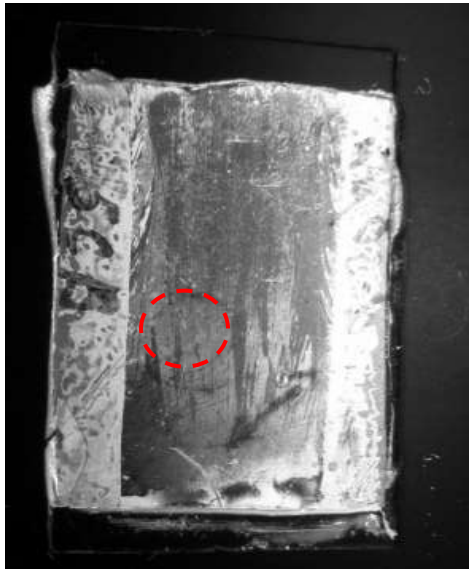


As_2S_3 (d=20nm)
LC – 5 CB
$T > Tc$
$\vec{H}$ = 8.5 kGs

In result we have homogeneous planar alignment

Photoalignment LC 5CB on pure glass

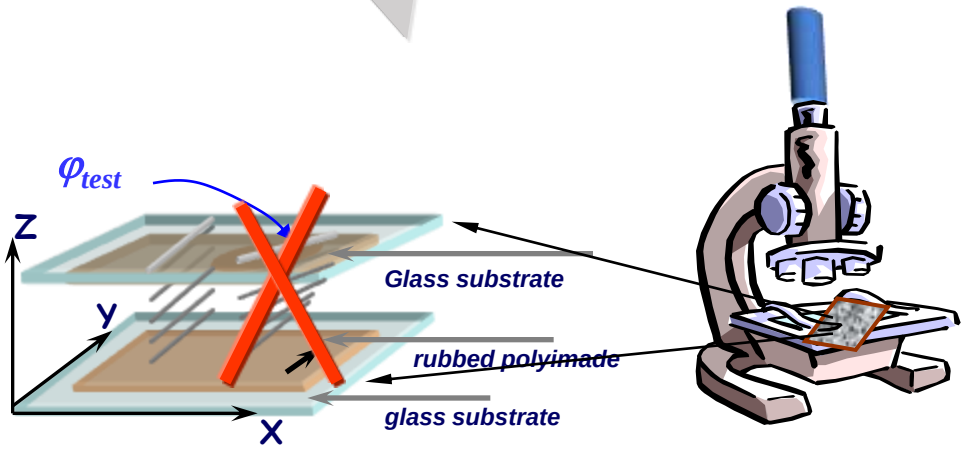




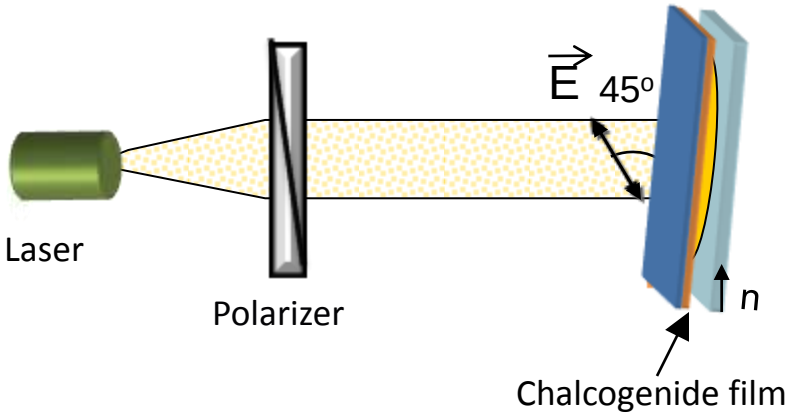
$$\lambda = 436,6nm$$

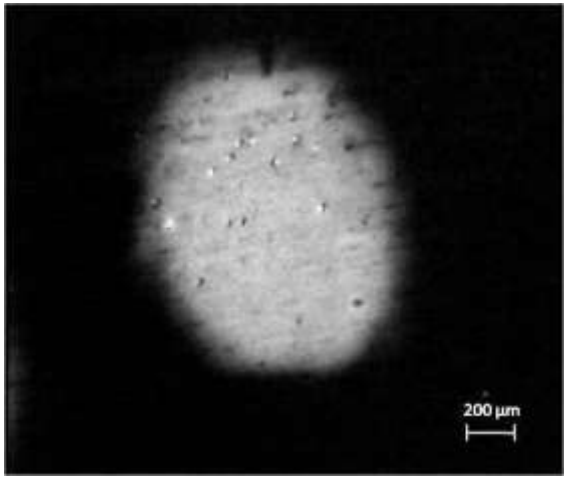
$$\tau_{\exp} = 30\,\min$$

I = 22 mW/cm²



Photoalignment: irradiation with Gaussian beam

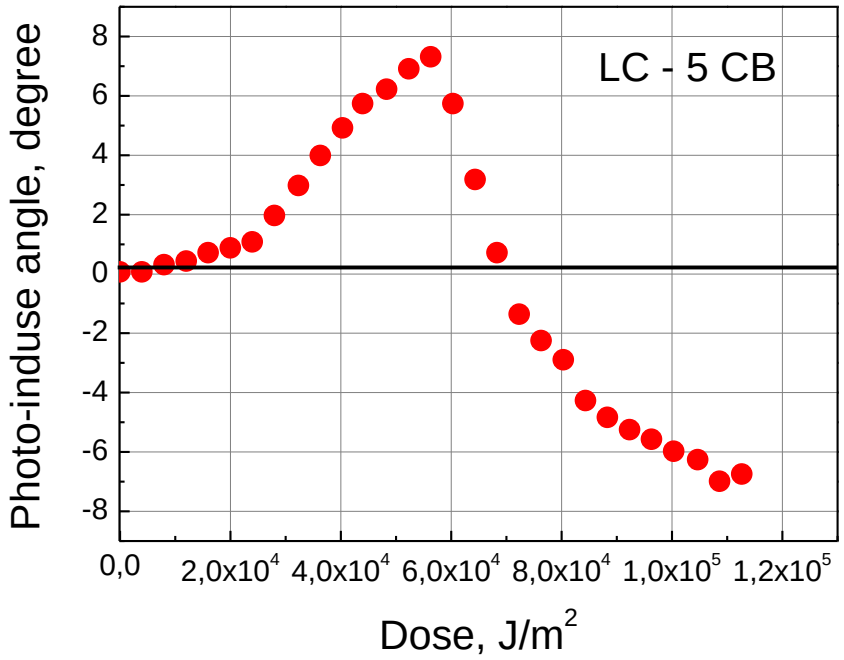




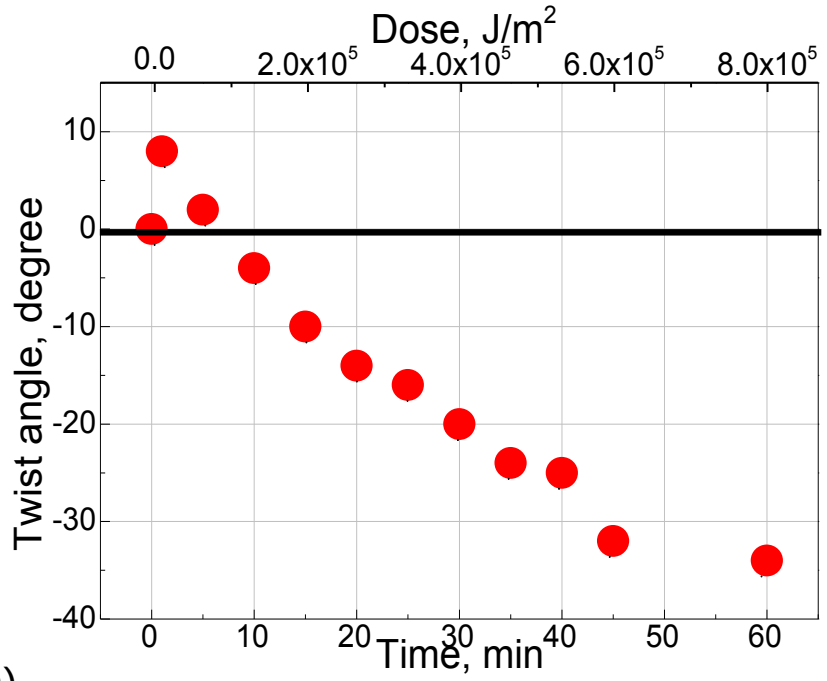
λ = 532 nm,
$I_{pump} \approx 2{,}4\ W/m^2$,
$\tau_{exp} = 30\,\min$
$As_{20}Se_{80}$ (d=200 nm)
LC 5CB

Photoinduce twist structure in cross polarization

Exposure dependencies; change of the orientation sign



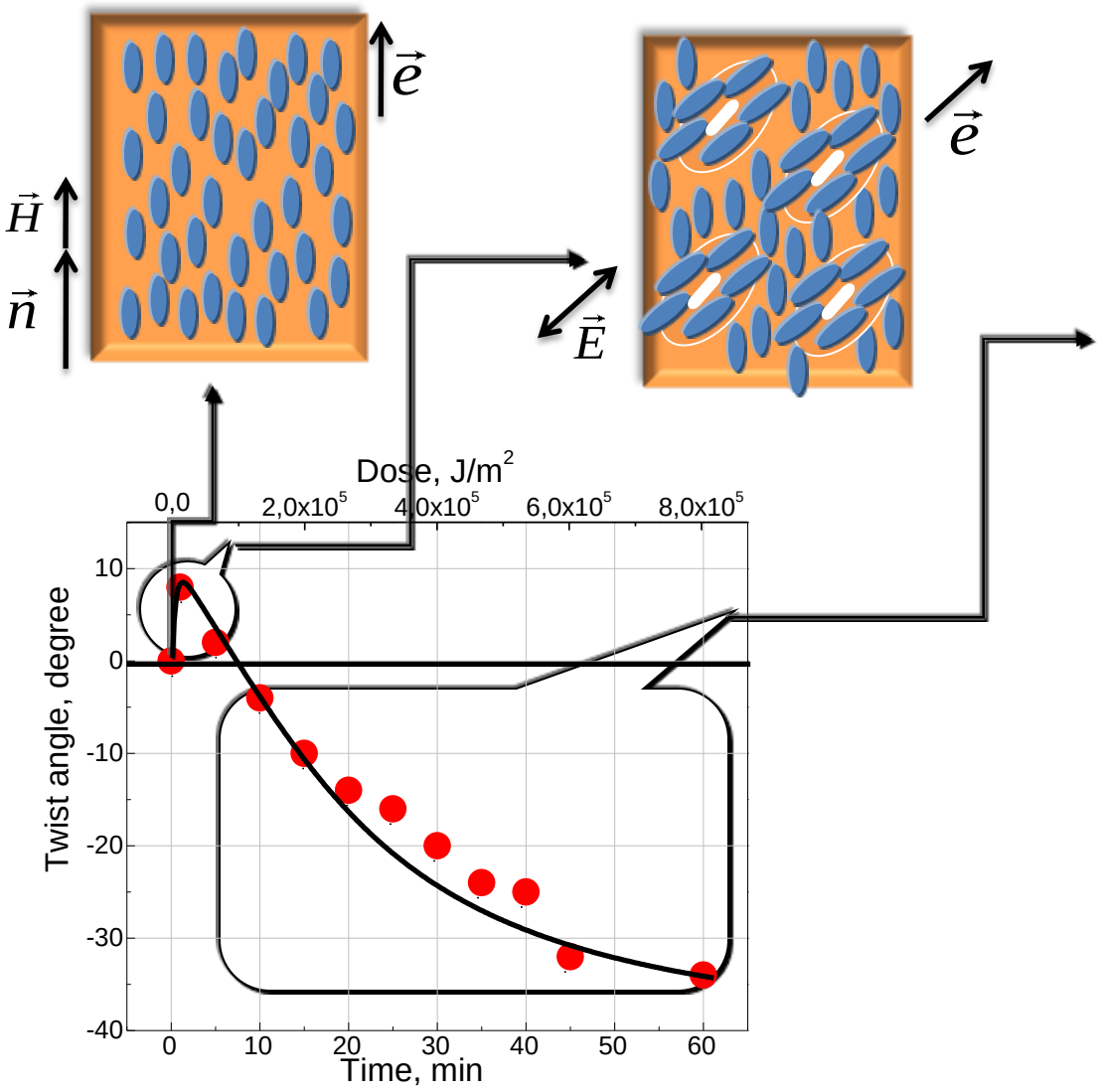
(a)



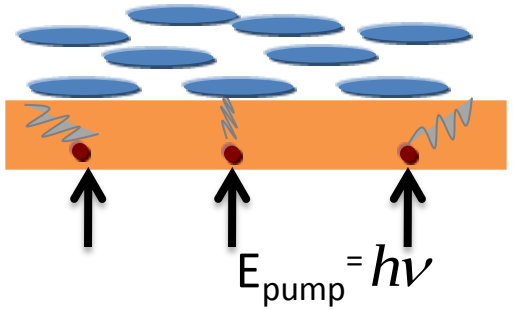
$As_{20}Se_{80}$ (200 nm)

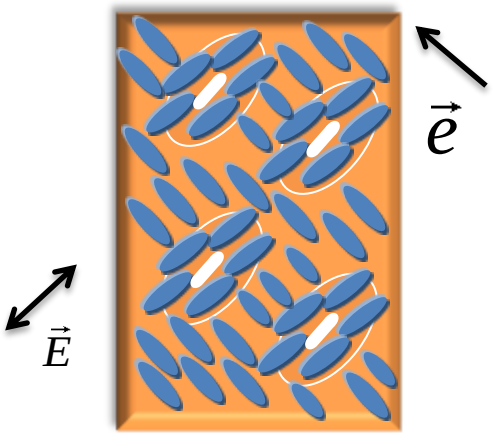
As_2S_3 (20 nm)

Model of photoinduce anchoring LC on chalcogenide glass films

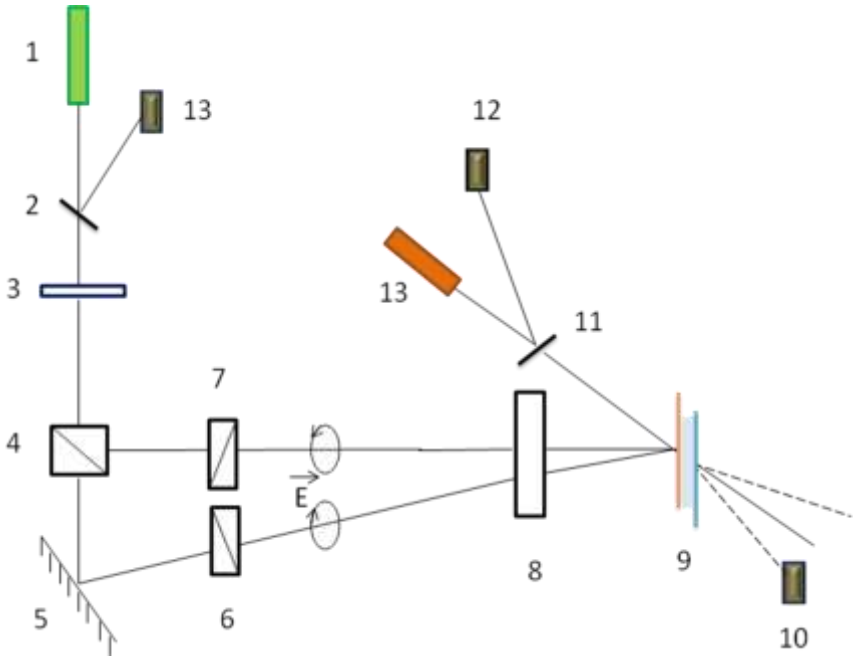


Desorption of LC from chalcogenide glass

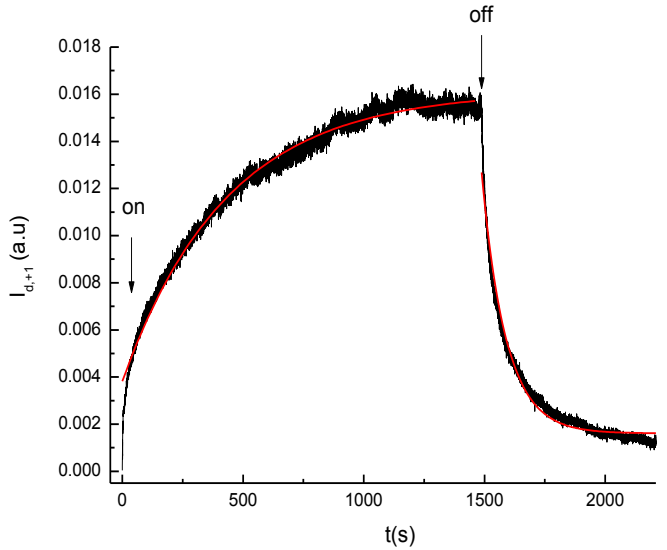




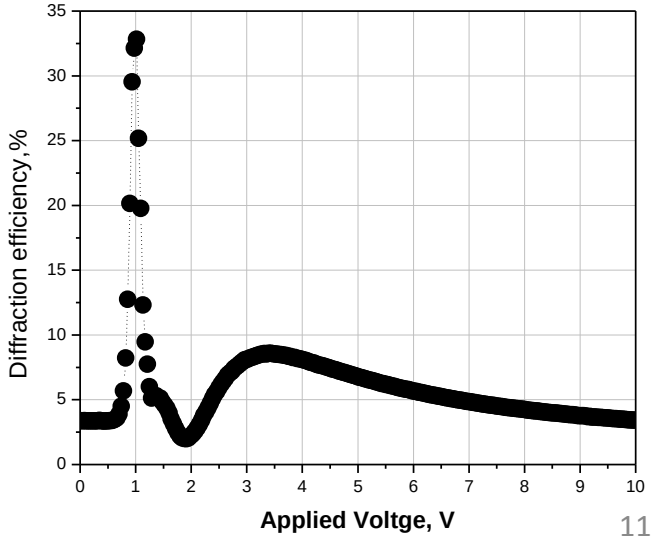
Recording the polarization gratings



Experimental set-up: 1 – DPSS Laser (λ = 532 nm); 2, 11 – beam-splitter plates; 3 - λ/2 wave plates 4 – beam-splitter cube; 5 – mirrors; 6,7 – polarizers; 8 – λ/4 wave plates; 9 – LC cell; 14 – He-Ne laser (λ = 632.8 nm); 10, 12, 13 – photodiodes.



$I_{0,pump}$ = 21·10^3 W/m^2.



Conclusions:

- We have got effective photoinduced anchoring of nematic liquid crystals on chalcogenide surfaces after irradiation with a polarized light.
- The direction of the easy orientation axis of LC on the chalcogenide depends on the irradiation dose.
- The photoalignment is governed by the light-induced anisotropy in a chalcogenide surface and the light-induced desorption of LC molecules from chalcogenide.
- We have proposed the model of the photoalignment of liquid crystal on chalcogenide glass.
- The LC cells with chalcogenide films can be used as effective IR transparent media for recording electrically controlled re-writable polarization holograms.

Thank you for attention