Liquid Crystal Elastomer Response to Light

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CPIP-LCI

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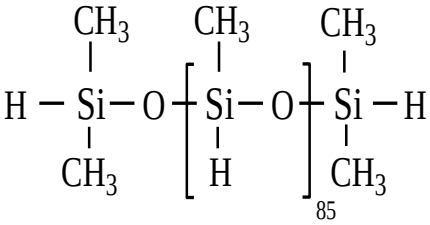
Objectives

- Observe the response of the Liquid Crystal Elastomer (LCE) to a source of light;
- Understand the key features of the Spatial Light Modulator (SLM);
- Use the SLM as a dynamic element;
- Apply light with intensity varying with position and time on the sample;

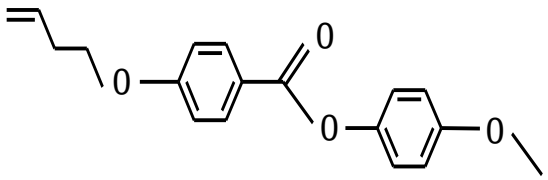
Background

- Liquid Crystal Elastomer*:

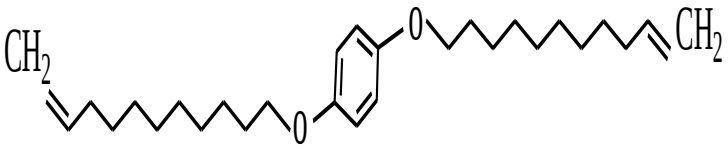
Rubber and Liquid Crystal!



Backbone

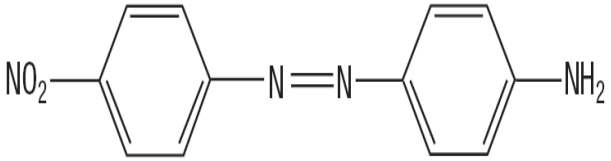


Mesogen

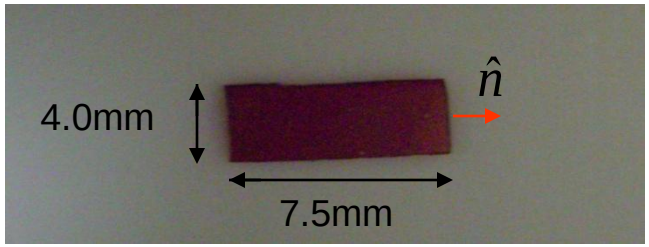


Cross-Linker (12%)

Doped



azo dye Disperse Orange III



*M. Camacho-Lopez, et al Nature Materials **3,** 307 (2004).

Background

- Change in the degree of order:
  - cis-trans transition (Azo Dye)
  - temperature

- The free energy of the elastomer

$$F = \frac{1}{2}Ye^2 + \frac{1}{2}aQ^2 - \frac{1}{3}bQ^3 + \frac{1}{4}cQ^4 + \alpha Qe$$

rubber

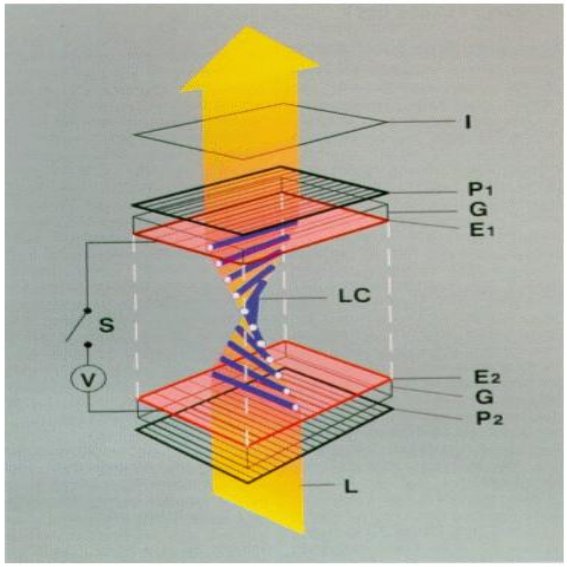
liquid crystal

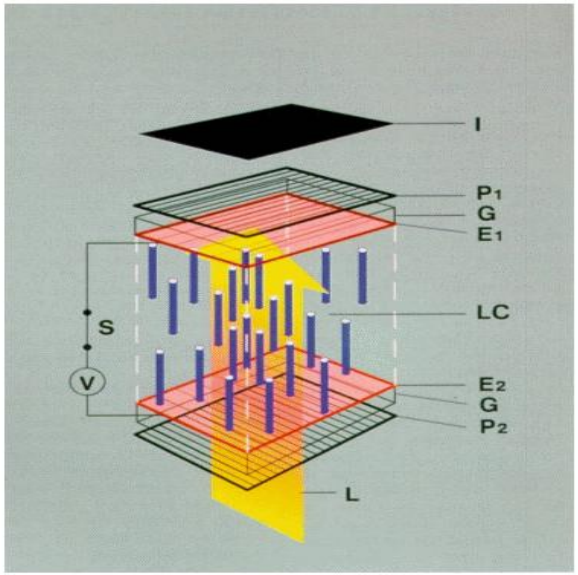
coupling term

Background

- SLM:

  Twisted Nematic cell used as dynamic element in experimental setups





Background

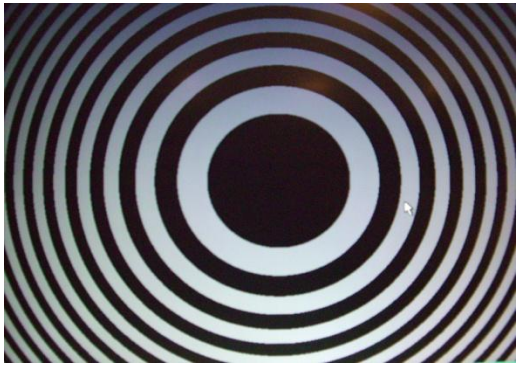
Transmissive SLM

Number of pixels:832 x 624

Pixel pitch: 32μm

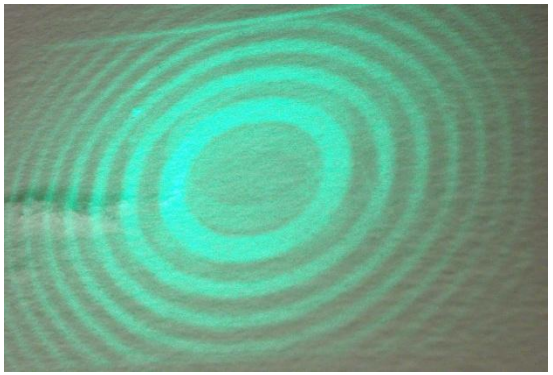
Image frame rate: max. 60Hz

Active area: 26.6mm x 20.0mm



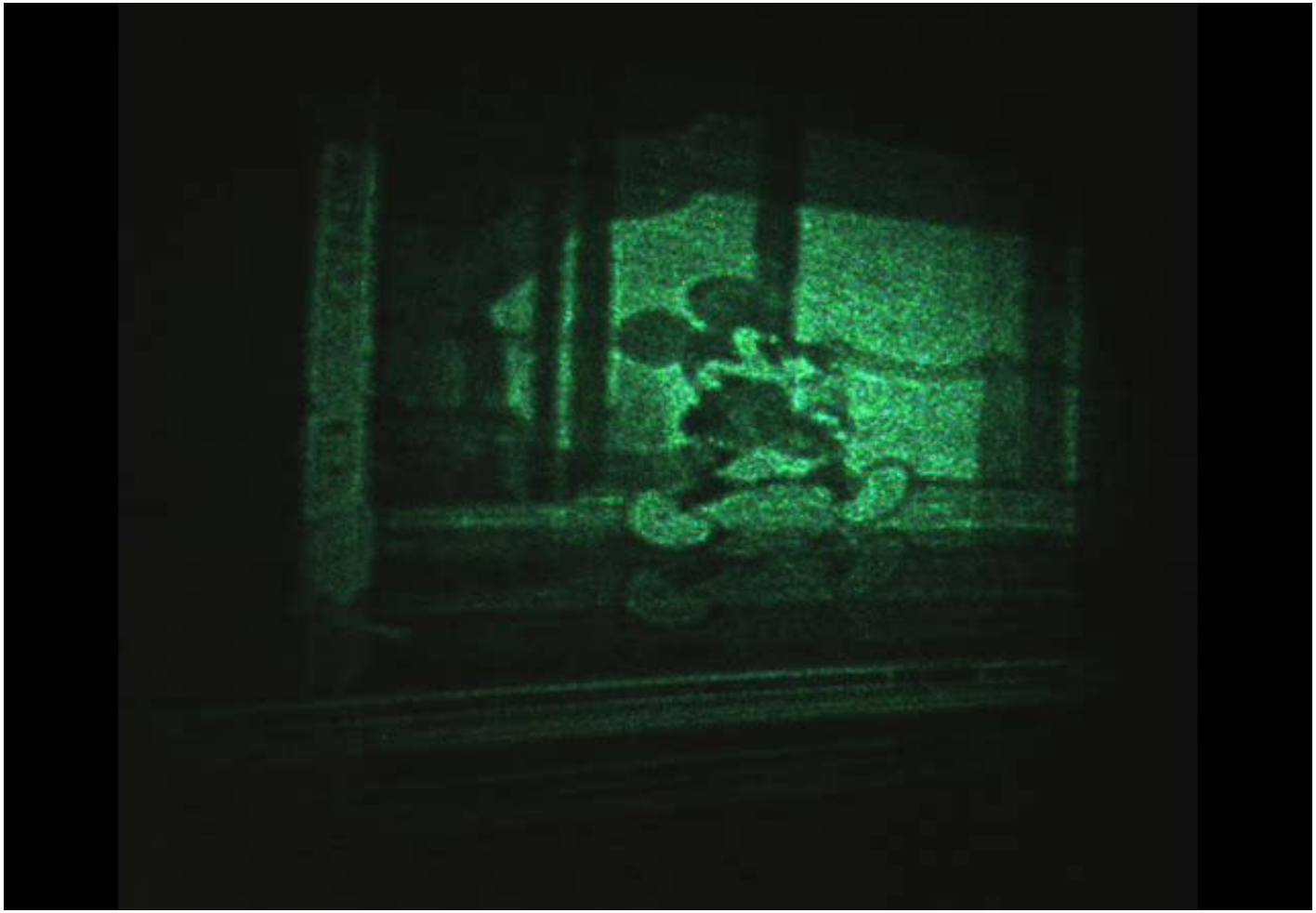
Computer

Laser through



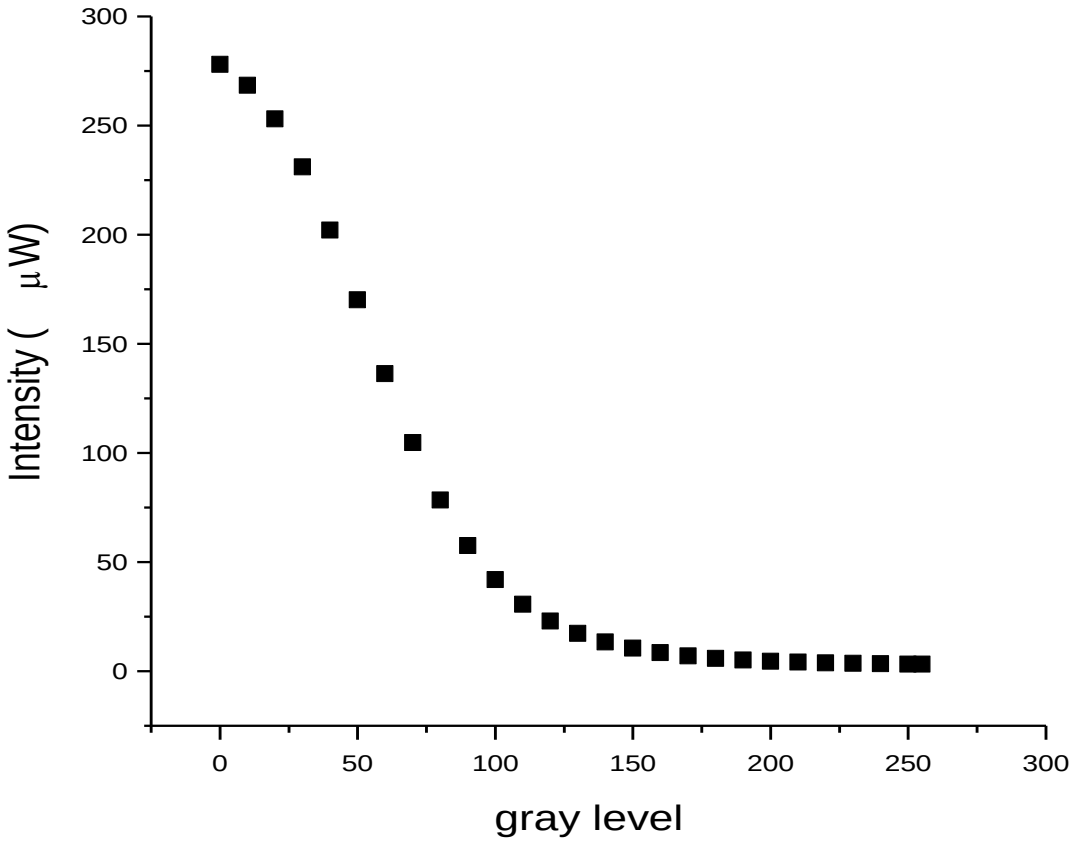
Image

Capability of SLM

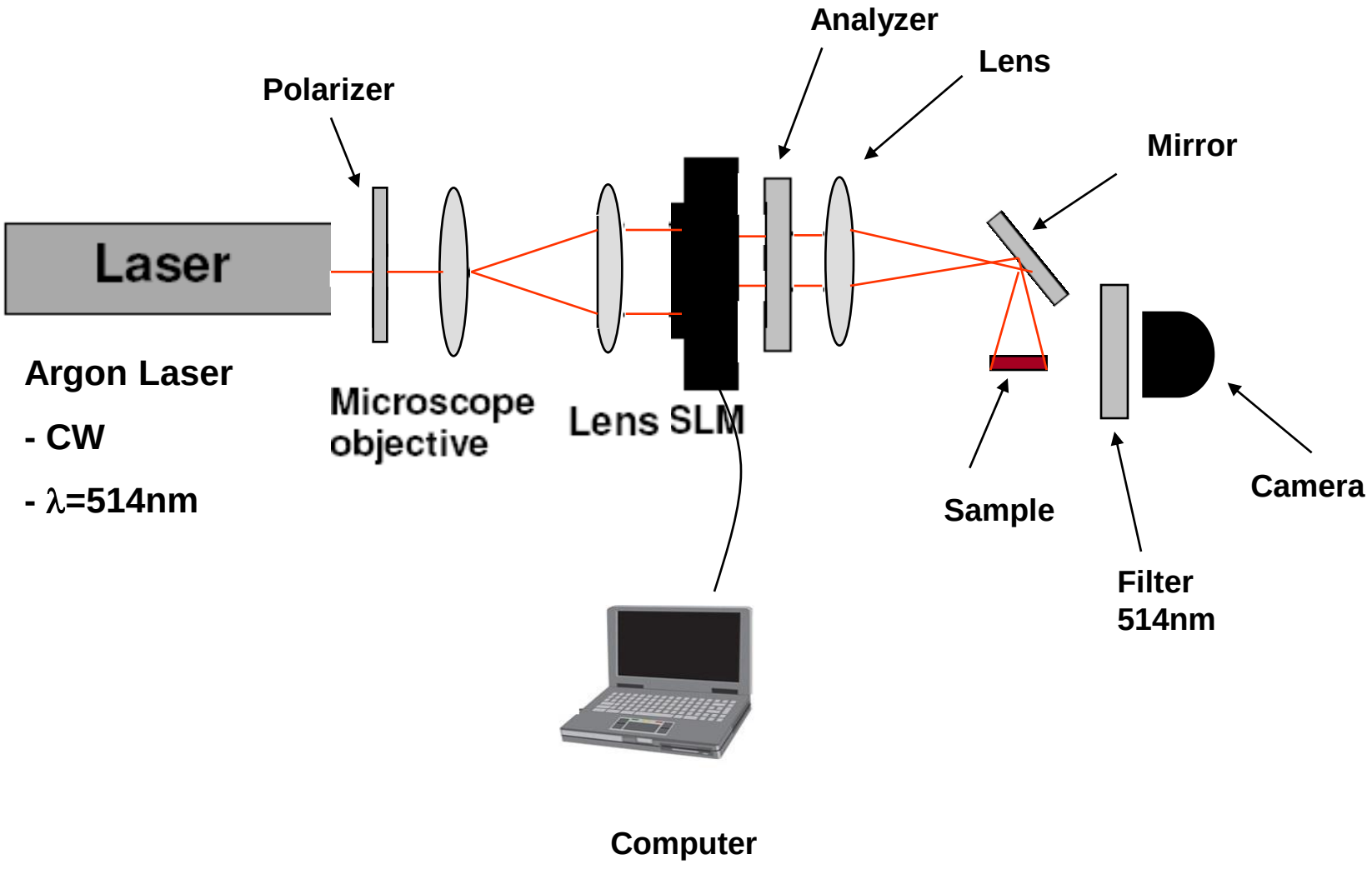


Background

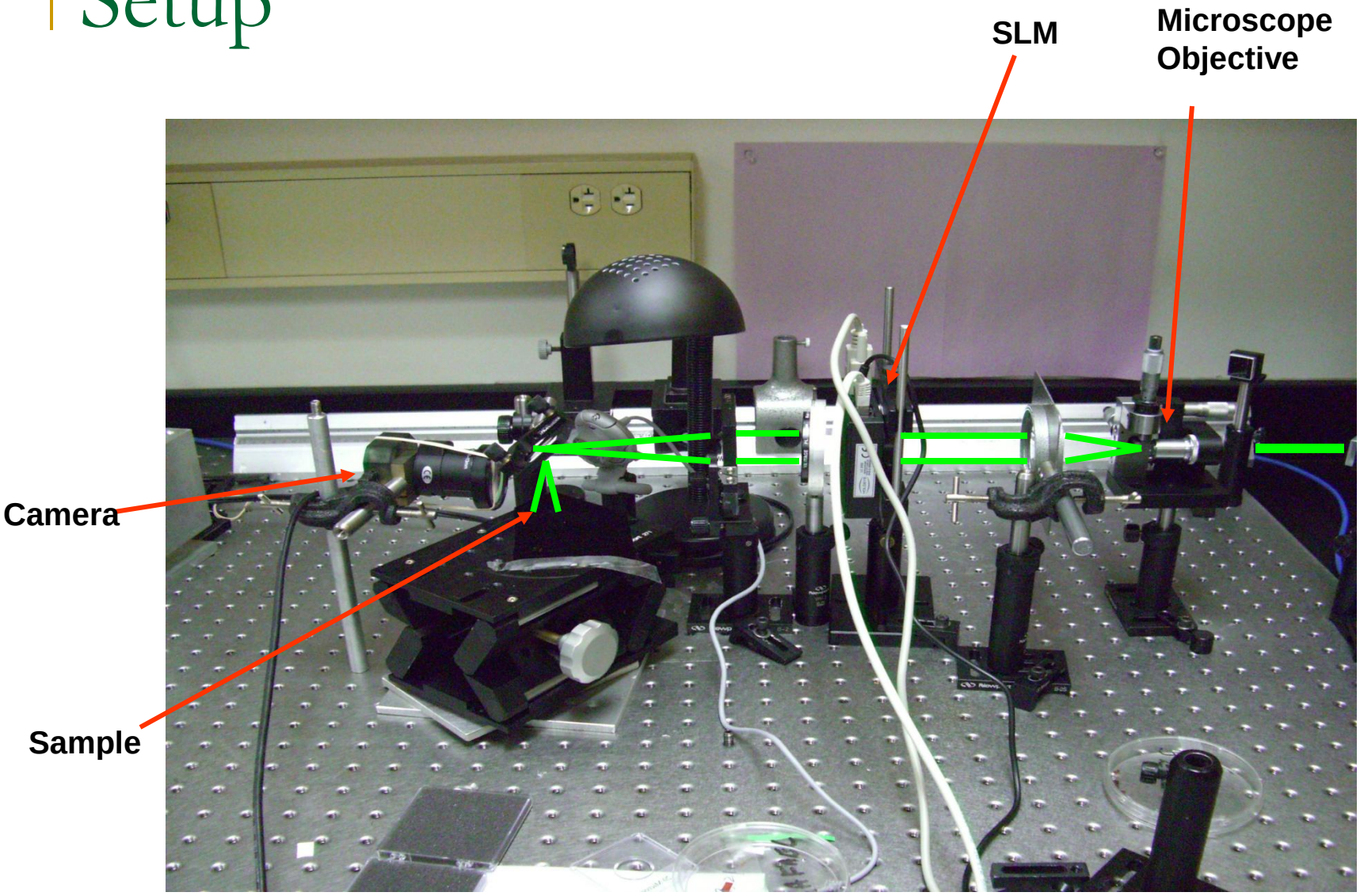
- Intensity vs. gray level:



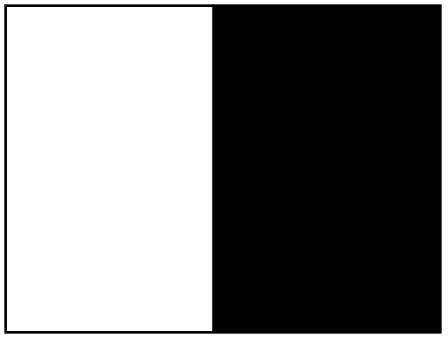
Setup


Analyzer
Lens
Polarizer
Mirror
Laser
Argon Laser
- CW
- λ=514nm
Microscope objective
Lens SLM
Sample
Camera
Filter 514nm
Computer

Setup

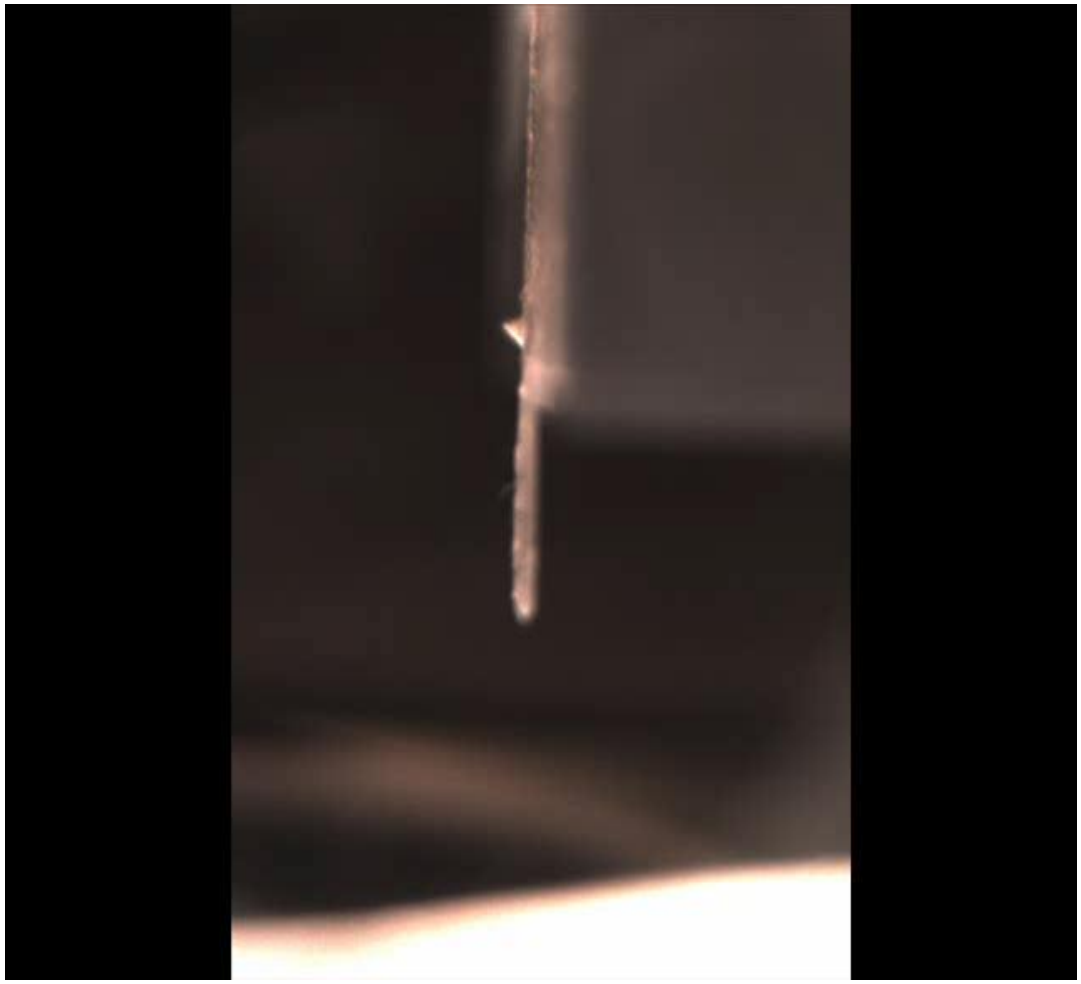


Results



P_{pump}=15mW

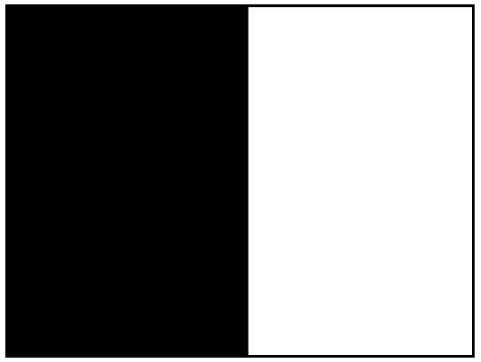
Results



P_{pump}=15mW

$t_{transition}$= 10s

Results



P_{pump}=43.73mW
$t_{transition}$= 10s

Conclusions

- The SLM can be used to control the intensity over the sample spatially and temporally
- This control allows one to move the LCE in some specific manner
- Coordinated movements depends on accurate control of the beam over the sample

Acknowledgements

Especial Thanks for:

Dr. Michele Moreira (muito obrigado mesmo!!)

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