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# COMPARISON OF GLISTENING FORMATION AND WHITENING OF HYDROPHOBIC ACRYLIC IOLS

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# FINANCIAL DISCLOSURE

- 
- P. Rozot
    - travel funded
    - consultant for Alcon, Carl Zeiss, Thea
    - no interest in the main subject of this presentation
  - M. Bouquey, C.Chong:
    - Acrylian employees
  - Y. Guldenfels
    - consultant for Carl Zeiss
    - no interest in the main subject of this presentation

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## PURPOSE

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- I. To compare the in vitro occurrence of glistening formation (number & size) and whitening of several hydrophobic acrylic IOLs

Glistening: microvacuoles

IOL usually remains  
transparent

<=> rain



Whitening: nanovacuoles

Smaller vacuoles, higher diffusion:  
IOL seems whitish

<=> fog





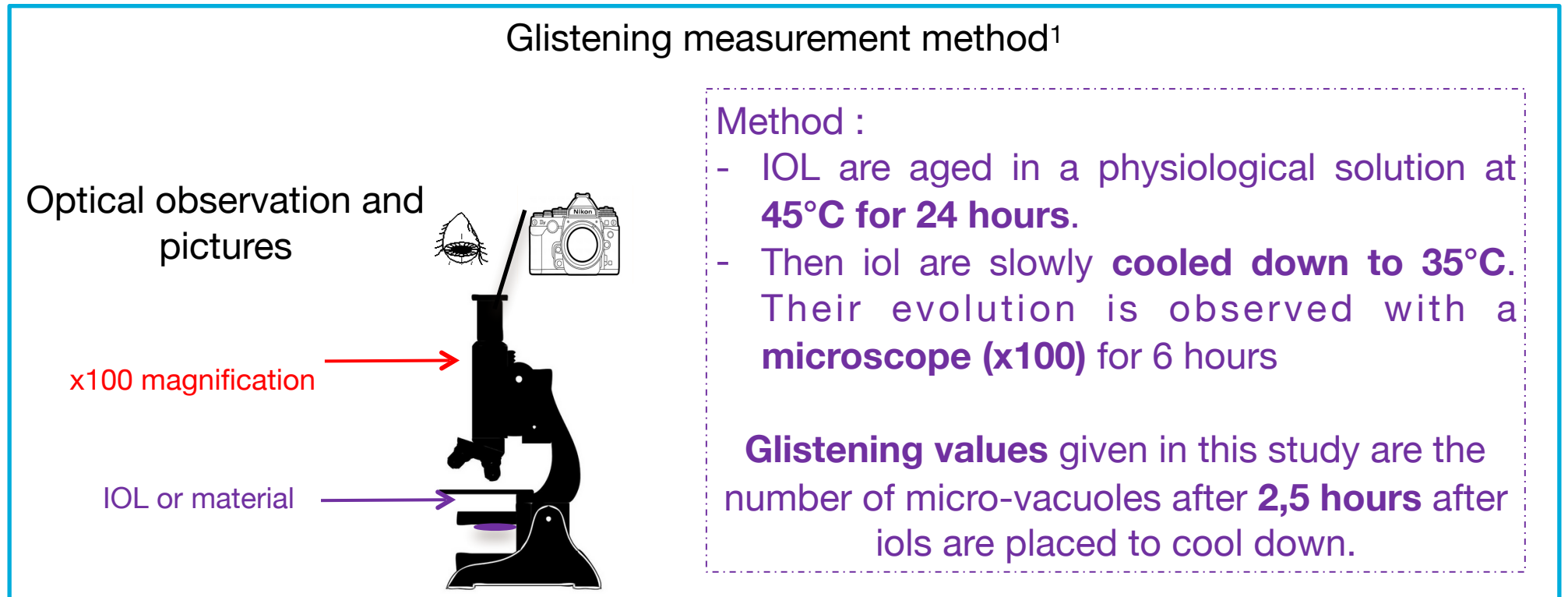
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## **MATERIAL & METHODS**

# I.

# GLISTENING MEASUREMENT METHOD


- The glistening is measured by counting microvacuoles in a hydrated lens/material from a picture taken with a optical microscope at x100 magnification. Microvacuoles diameter is also measured.



<sup>1</sup>Clinical Ophthalmology 2013;7 1529-1534, B. E. Thoimes & T. A. Callaghan

# I.

# GLISTENING MEASUREMENT METHOD

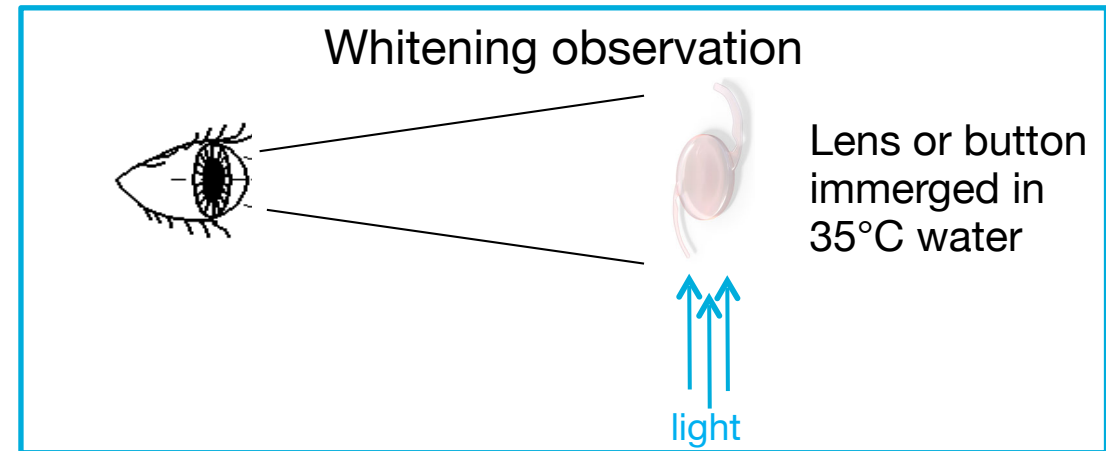
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- **ImageJ software** is used to determine the **number** and the **diameter** of **microvacuole (=MV)**.
    - ❑ The analysis is made on the most representative picture, which is the one with the most homogeneous and the highest MV's density
    - ❑ Over the five pictures of the sample, the most representative is usually the one of sample's center
  - **Determination of MV's diameter**
    - ❑ The **scale** on Image J is measured and set using a **sight**
    - ❑ Once the scale set, ImageJ provides MV's diameter in  $\mu\text{m}$
  - **MV's counting**
    - ❑ MV are manually counted

*NB : the depth of field is around 0.2 mm, so MV are counted in a volume of  $1 \text{ mm}^2 \times 0.2 \text{ mm (thickness)} = 0.2 \text{ mm}^3$*

# II. WHITENING MEASUREMENT METHOD

## ➤ What's the whitening?

- ❑ The material (lens or button) immersed in water **becomes lightly opalescent to white**
- ❑ This phenomena can be observed without a microscope, by lighting the material from its side



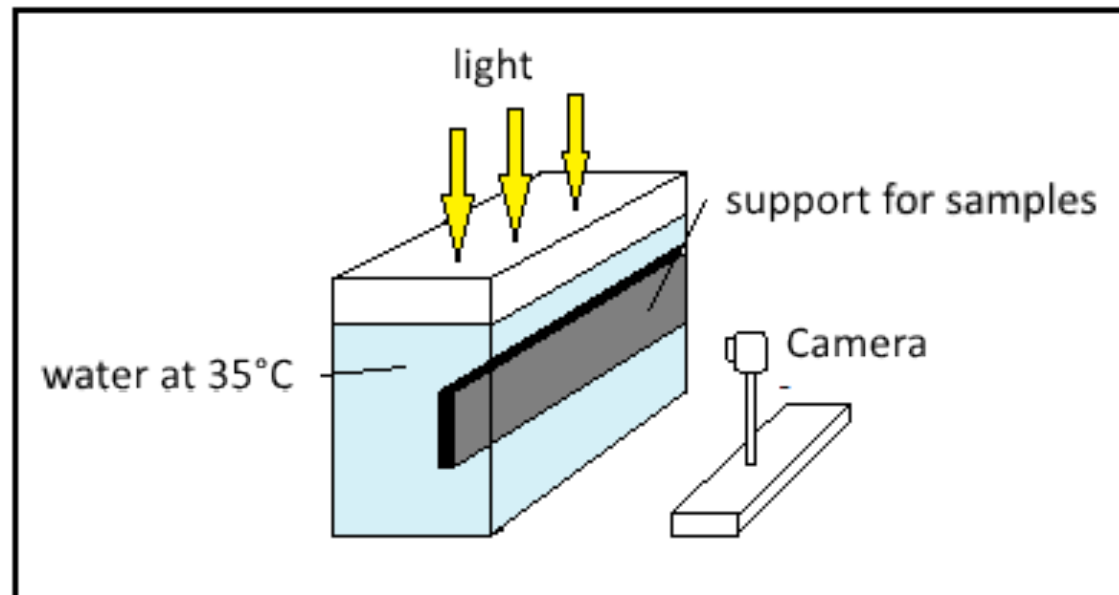
- ❑ Whitening is due to the **diffusion** of light<sup>2</sup> through « **nano-vacuoles** »
  - The intensity of diffused light is proportionnal to  $\frac{1}{\text{vacuoles' diameter}^6}$
  - This intensity can be measured by a RGB histogram

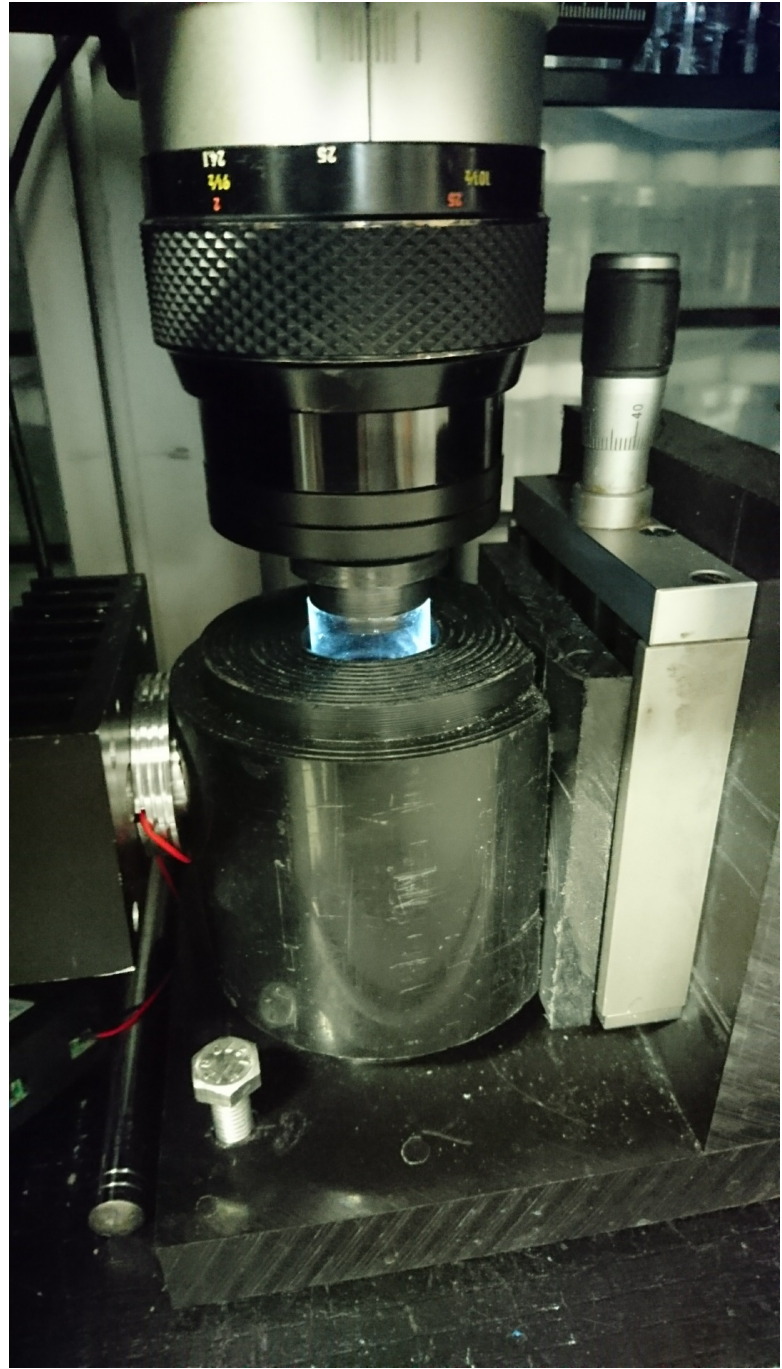
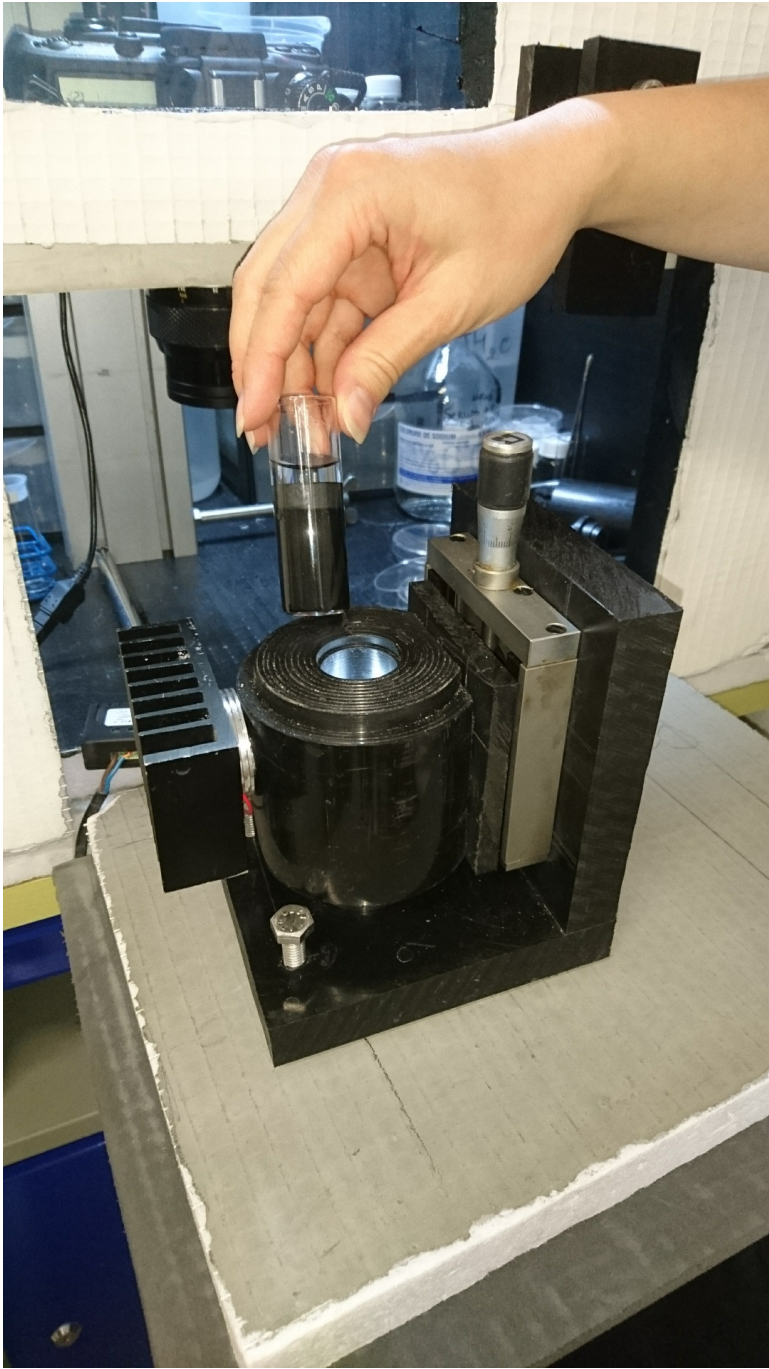
<sup>2</sup>This diffusion phenomena is not exclusive to IOL, it is the same with particles/micelles in water (milk as an example)



# III. WHITENING

- Whitening analysis of aged buttons
  - ❑ Buttons are aged in 35°C pure water over 2000 hours
  - ❑ A picture is taken and analyzed with ImageJ each week to study buttons's aging





# II. WHITENING

## ➤ Whitening measurement with ImageJ software

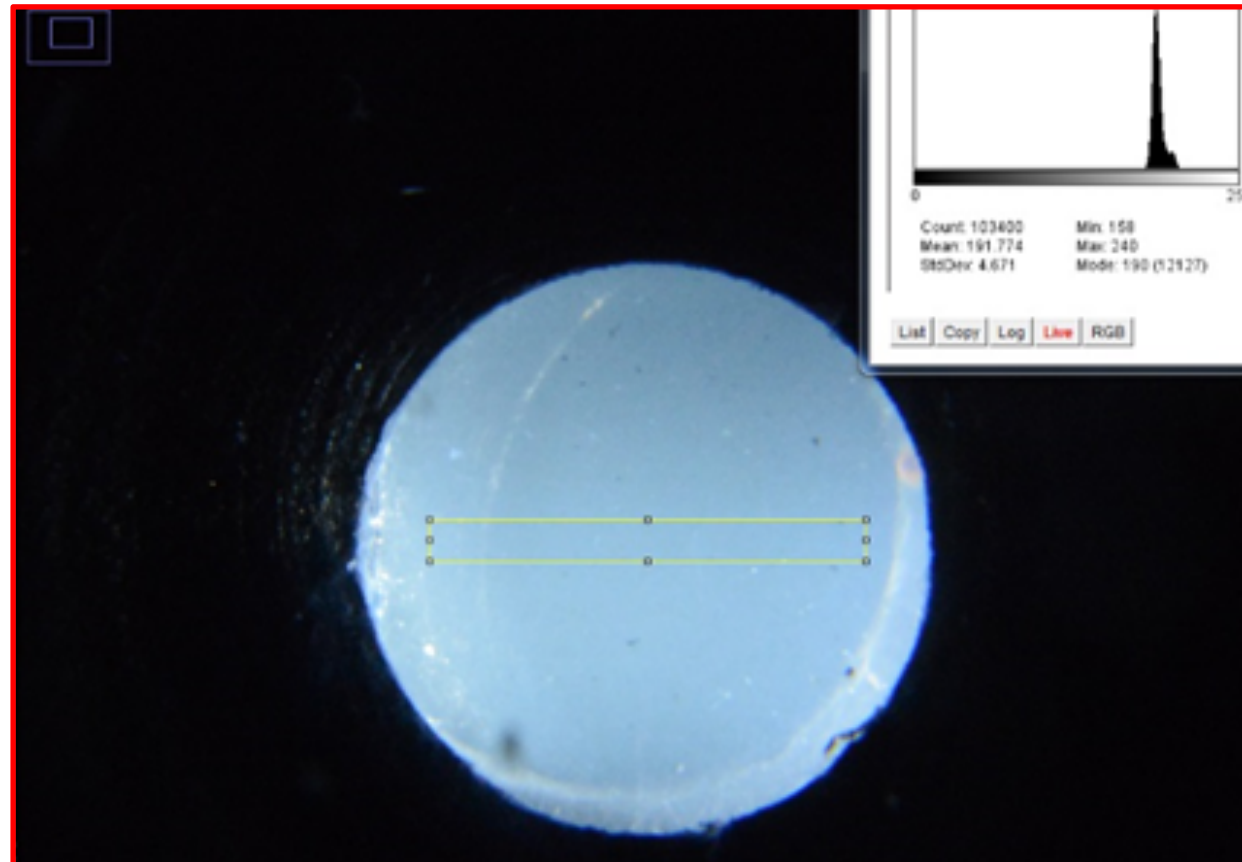
The screenshot shows the ImageJ software interface. The main window displays a dark image with a row of circular features. One feature is circled in red and labeled '1'. The 'Analyze' menu item is circled in red and labeled '2a'. A histogram window is open, showing a sharp peak at a mean value of 11.100, which is circled in red and labeled '3'. The histogram window also displays the following statistics: Count: 2688, Min: 9, Max: 16, StdDev: 1.052, and Mode: 11 (930).

Statistic	Value
Count	2688
Mean	11.100
StdDev	1.052
Min	9
Max	16
Mode	11 (930)

After **selecting the area** to be analyzed (1),  
the function « analyze » (2a)  
« **histogramm** » (2b) give a mean value (3)  
corresponding to the **whitening measurement**  
(with an arbitrary unit)

## II. WHITENING

- Example of whitening measurement with ImageJ software



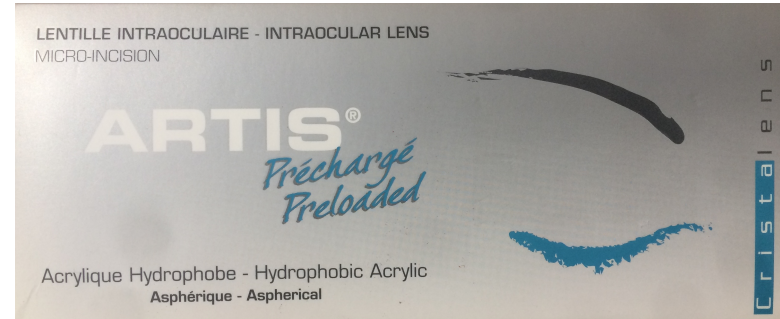


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# RESULTS

# STUDIED IOLS FOR GLISTENING

Manufacturer	Lenses/Material
Abbott	PCB00
Acrylian	AcryGem 1 button (1 mm-thick)
Acrylian	AcryGem 2 button (1 mm-thick)
Alcon	AcrySof IQ
Bausch & Lomb	EnVista
Cristalens	Artis PL 1.8
Hoya	Hoya Vivinex iSert XY1 yellow
Nidek	EyeCee one preloaded
Zeiss	CT Lucia 601P

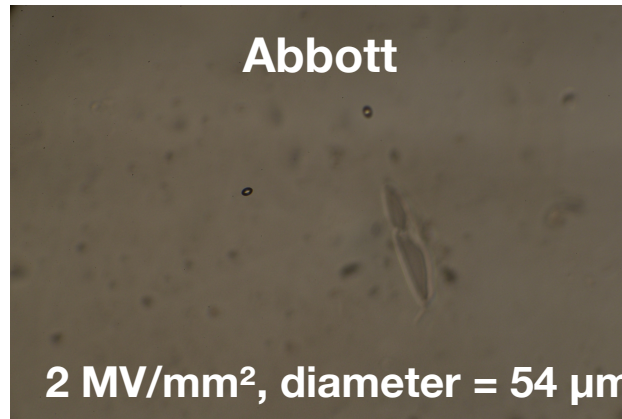
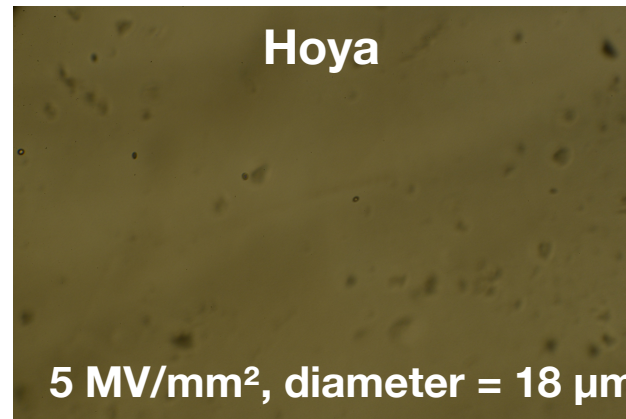
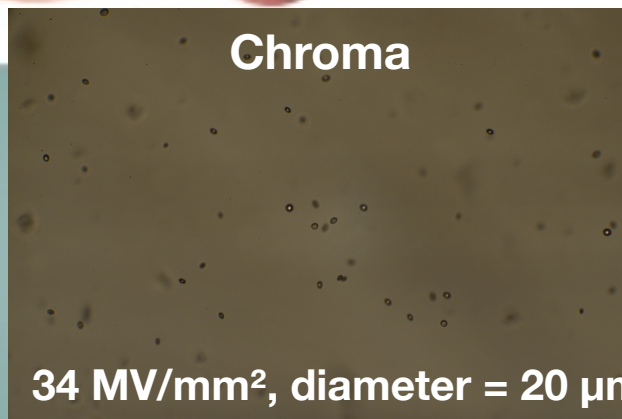
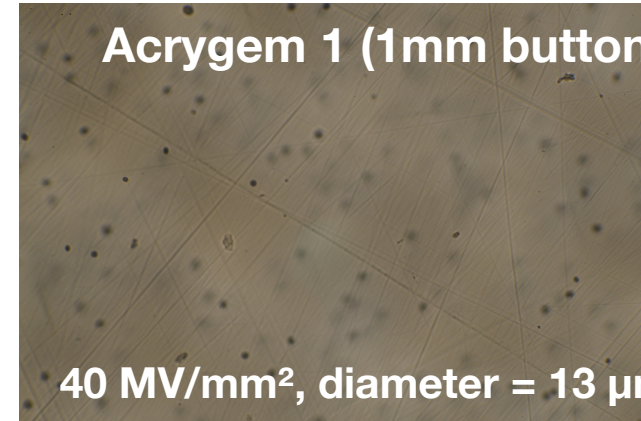
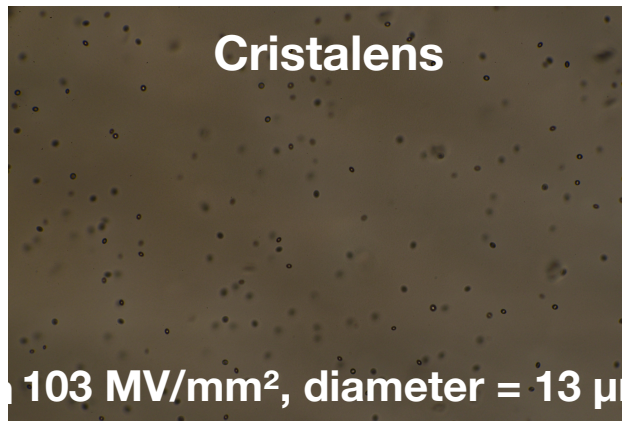
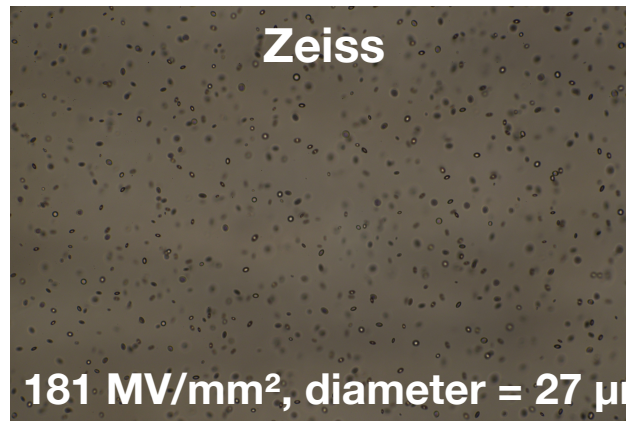
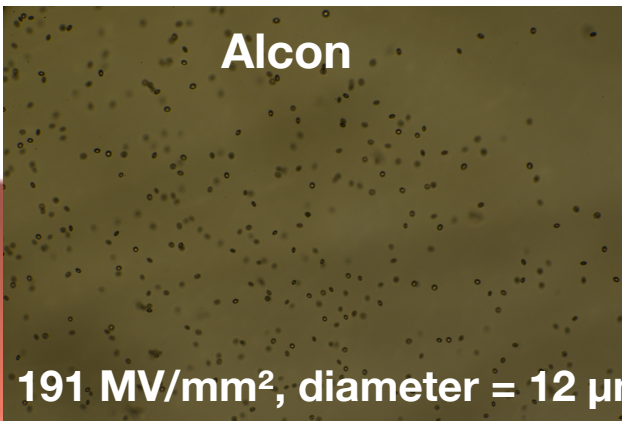


# GLISTENING RESULTS

<b>Manufacturer</b>	<b>Lenses/Material</b>	<b>Number of MV/mm<sup>2</sup></b>	<b>MV's diameter (µm)</b>
Alcon	AcrySof IQ	191	12
Zeiss	CT Lucia 601P	181	27
Cristalens	Artis PL 1.8	103	13
Acrylian	AcryGem 1 button (1 mm-thick)	40	14
Nidek	EyeCeeOne preloaded	34	20
Hoya	Hoya Vivinex iSert XY1 yellow	5	18
Abbott	PCB00	2	54
Bausch + Lomb	EnVista	0	0
Acrylian	AcryGem 2 button (1 mm-thick)	0	0


*IOL's vergences are between 16,5 and 26 D*

## II. COMMERCIAL LENSES AND ACRYGEM 1 & 2 MATERIALS



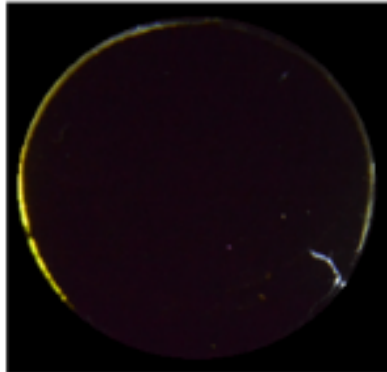


# WHITENING RESULTS

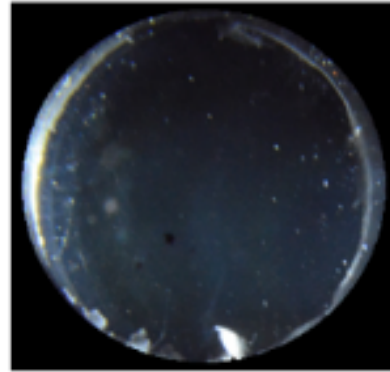


IOL	Diopter	white at t=0	white at t=119j	$\Delta$ (whitening)
Vivinex	+25.5D	4.43	6.53	2.10
Acrysof	+20.0D	7.39	15.42	8.03
EyeceeOne	+21.5D	10.02	27.73	17.71
Tecnis	+22.5D	8.02	29.08	21.06
EnVista	+20.0D	17.86	45.73	27.87
Micropure	-	65.85	125.70	59.85
EOS	+26.5D	9.06	94.01	84.95
Focusforce	+21.5D	10.64	217.29	206.65

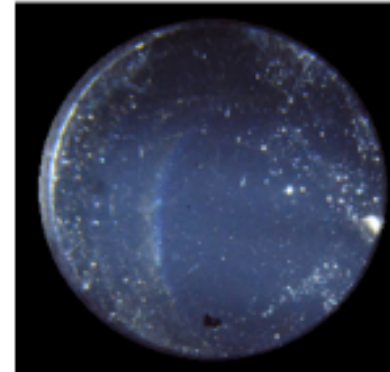
# WHITENING RESULTS



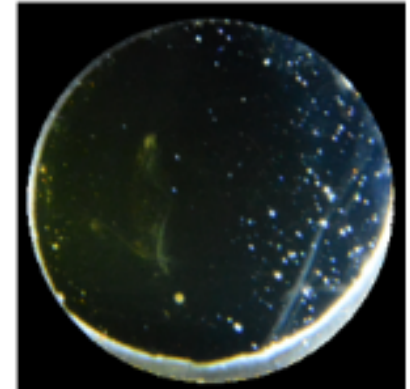
Acrysof (15.42)



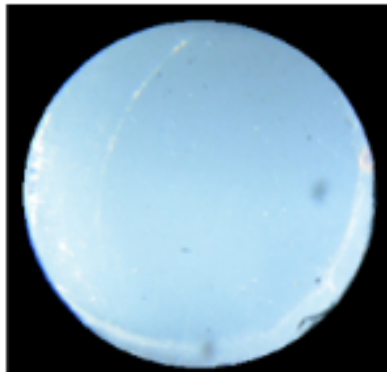
EnVista (45.73)



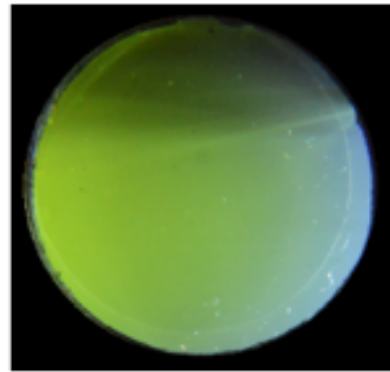
EOS (94.01)



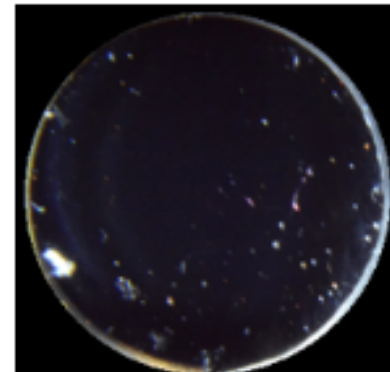
Eyeceeeone (27.73)



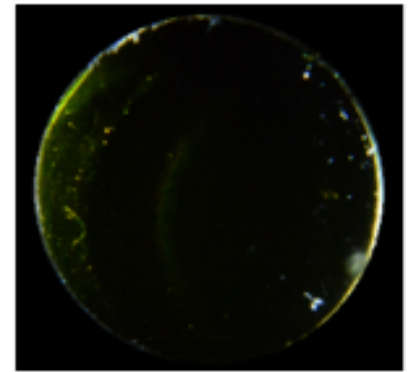
Focusforce (217.29)



Micropure (125.70)



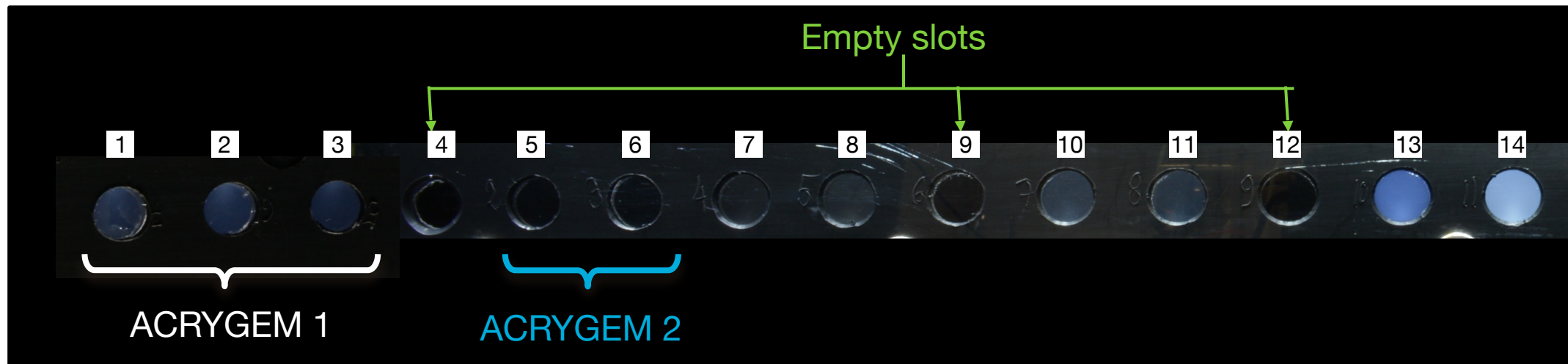
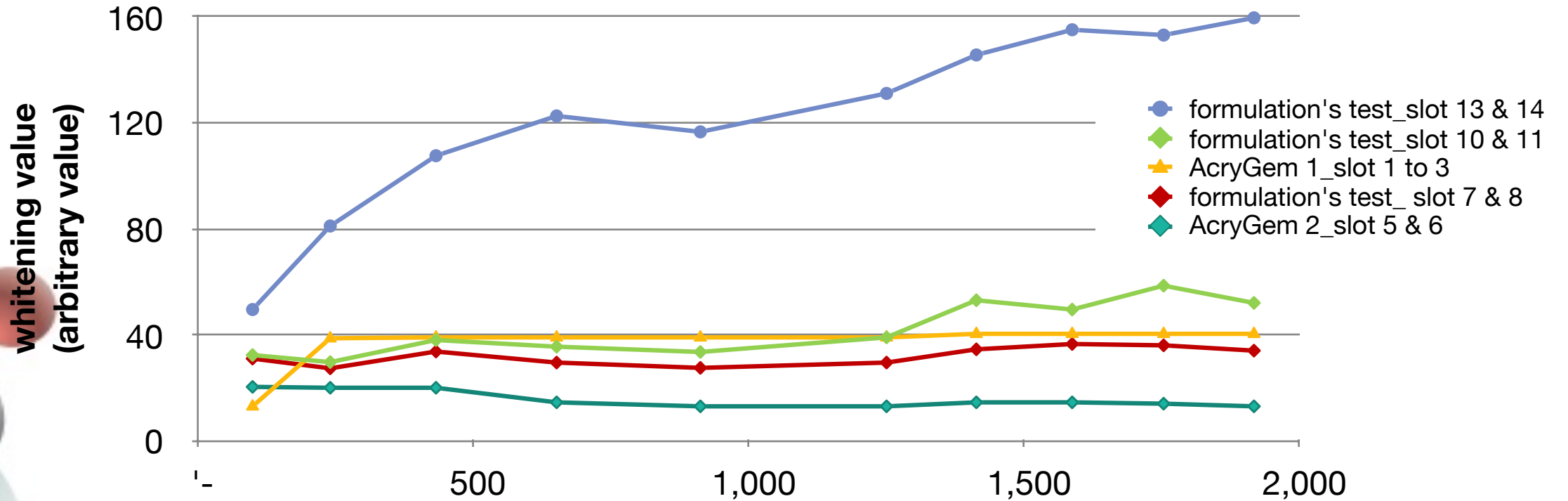
Tecnis (29.08)




Vivinex (6.53)


*At 119 days*

# WHITENING RESULTS



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- Group 1 : no significant whitening :
    - o Vivinex (Hoya) et Acrysof (Alcon)
  - Group 2 : mild whitening :
    - o Eyeceeeone (Nidek), Tecnis (Abbott) et EnVista (Santen)
  - Groupe 3 : moderato whitening:
    - o Micropure (PhysIOL) et EOS (Cristalens)
  - Groupe 4 : high whitening :
    - o Focusforce (Anadolu Tip Teknolojileri)

# CONCLUSION

- 
- Hydrophobic acrylic IOLs
    - less PCO than hydrophilic
    - inclusion of small particles of water favored by temperature changes, especially from warm to cold
    - evolutivity ?
    - clinical significance discussed
      - glistening: little effect
      - whitening: more light diffusion (scotopic)
  - Hydrophilic: no hydric particles, but sometimes intra optic or surface calcifications
  - go on looking for the best material !