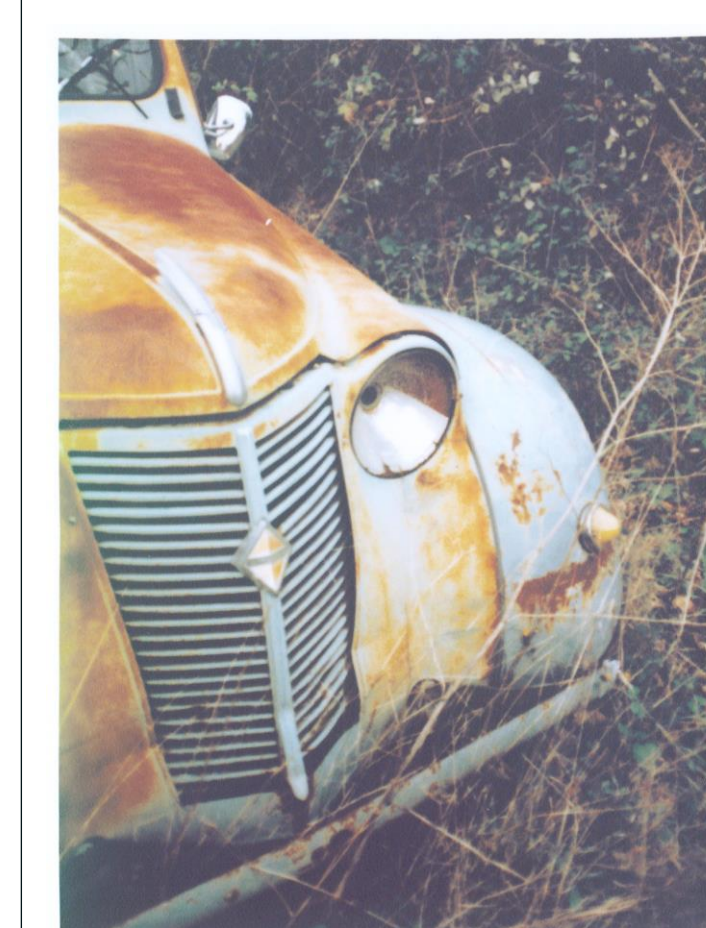


LIGHTCONTROL : a low-tech tool for monitoring the display of light sensitive museum artefacts

Marie Dubail, Bertrand Lavédrine,
CRCC

Introduction

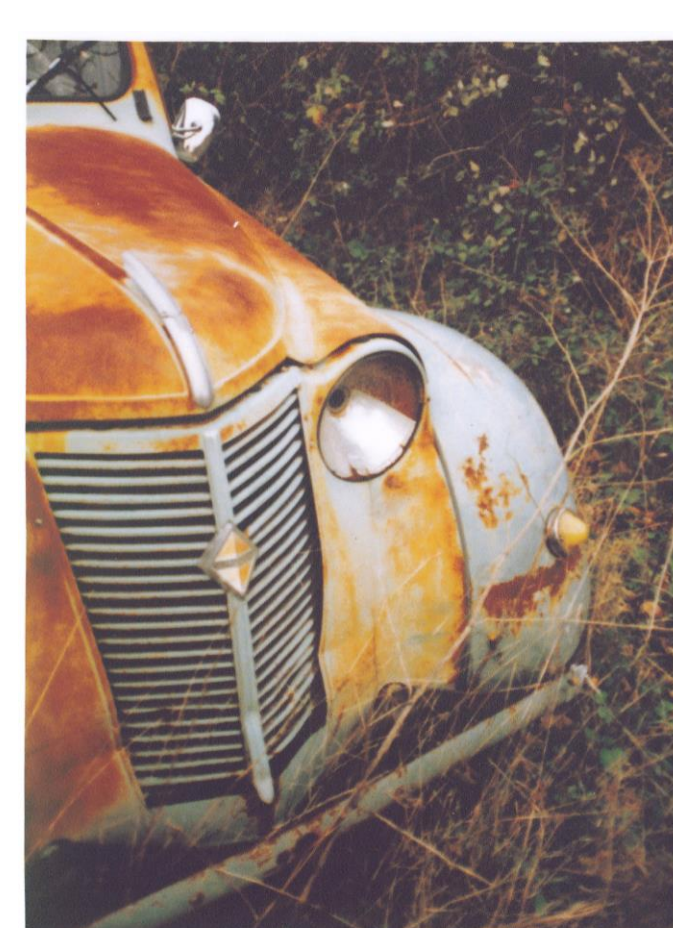
An extended exposure to light may cause some artwork to undergo drastic changes such as discoloration, fading, yellowing or brittleness. Although it is difficult to predict the light sensitivity of a specific artwork, it is generally admitted that the most sensitive cultural artifacts include graphic documents, colour photographs and textiles. Maximum luminous exposure limits were recommended for each types of artifacts¹ to limit the degradation during display. A few years ago, we introduced a light dosimeter^{2,3} composed of photosensitive dyes coated on a paper support to monitor the light exposure. Unfortunately, the industrial production turns out to be difficult. The goal of this new research was to improve the industrial coating and the quality control by using inkjet print technology, allowing us to print a non toxic light dosimeter, on demand, called LightControl. This research was founded by an AXA ART Research grant.



Condition after 100 years display at 200 lux for 50 days per years



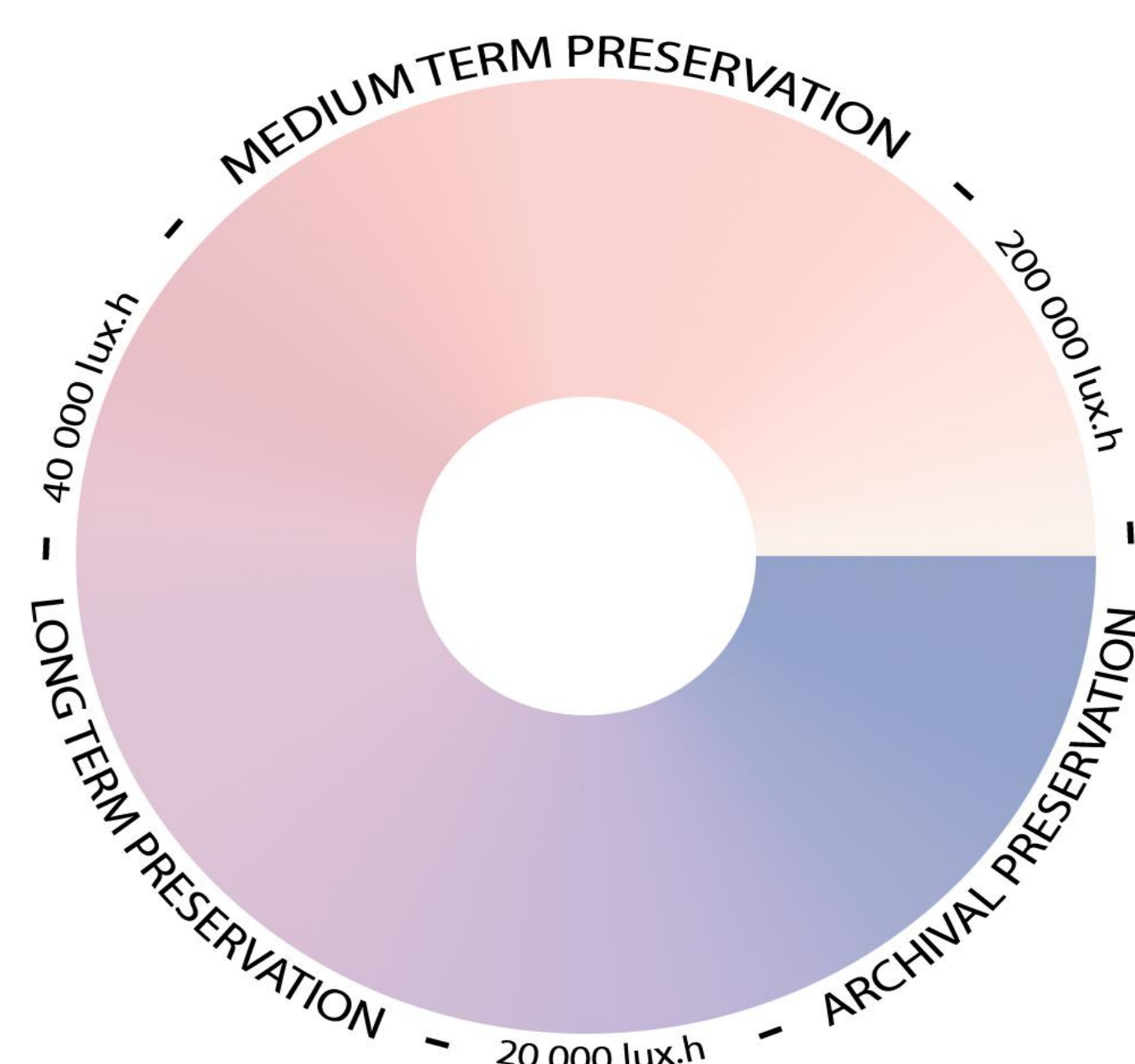
Condition after 100 years display at 200 lux for 100 days per years



Condition after 100 years display at 200 lux for 10 days per years : just noticeable fading



Before display



As long as LightControl exhibit a blue hue after one year display, it means that we are in the safe zone : a light sensitive artefact such as a Canon MP490 Inkjet print has a limited risk to exhibit a noticeable light fading after 100 years of display in the same condition. Over this limit, there is a high risk of fading after 100 years. (one day is 10 hours light display)

Formulation

The first part of this project consisted in developing a photosensitive ink made of non toxic reagents. The rheological properties had to match the piezoelectrical printer requirements⁴. Thanks to a dedicated Raster Image Processor, we were able to control the specific ink amount and thus the light sensitivity of the dosimeter, characterized by a progressive colour variation from blue to pink and white as the exposure of light increases.

Ageing tests

Printed samples were exposed to different light sources (Figure 1) within climatic chambers under several temperatures and relative humidity conditions. Color values ($L^*a^*b^*$) of each sample were then measured to calculate the color change ΔE^*_{76} as a function of light dose (illuminance * time of exposure).

Results showed an impact of environmental conditions (temperature and relative humidity) and light spectrum of the source on the LightControl sensitivity. To minimize these effects, the samples were protected by a clear plastic. Figure 2 shows the sensitivity of the printed dosimeter under several light sources. When exposed to daylight spectrum, LightControl (Figure 3) appears to be more sensitive to red light and then to shorter wavelengths.

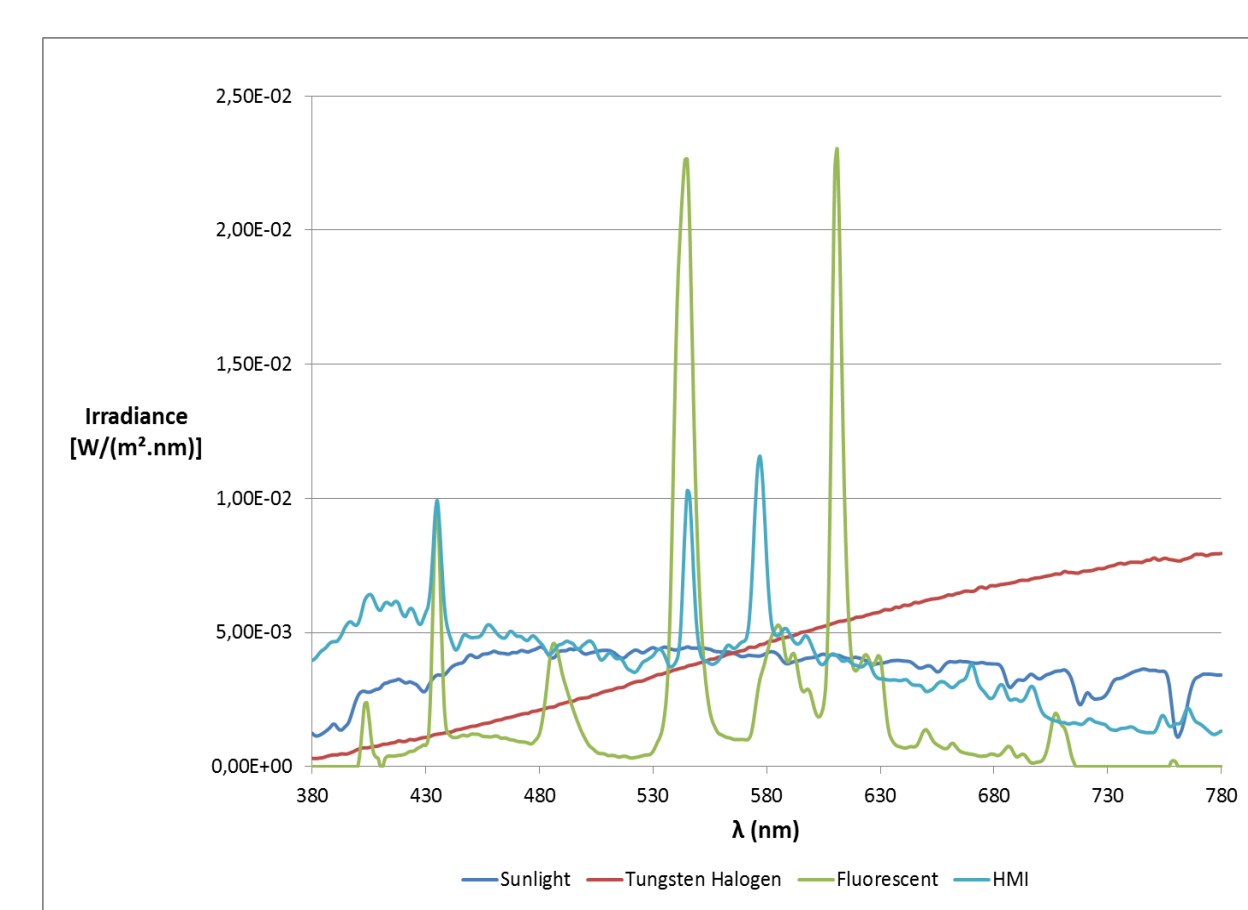


Figure 1 - Spectral power distributions of four light sources measured at 300 lux

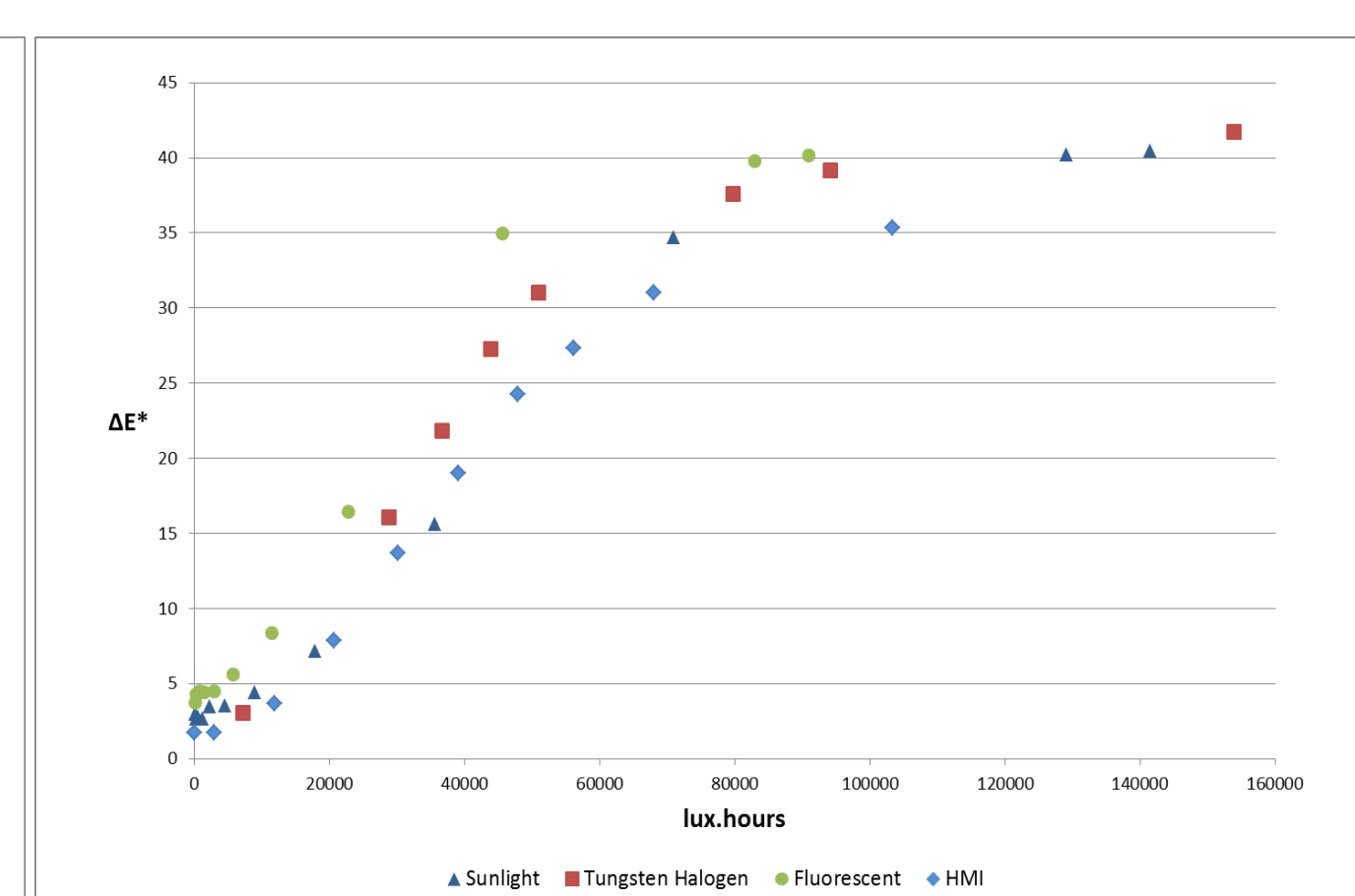


Figure 2 - Color difference ΔE^* as a function of light dose for four LightControl aged under four light sources

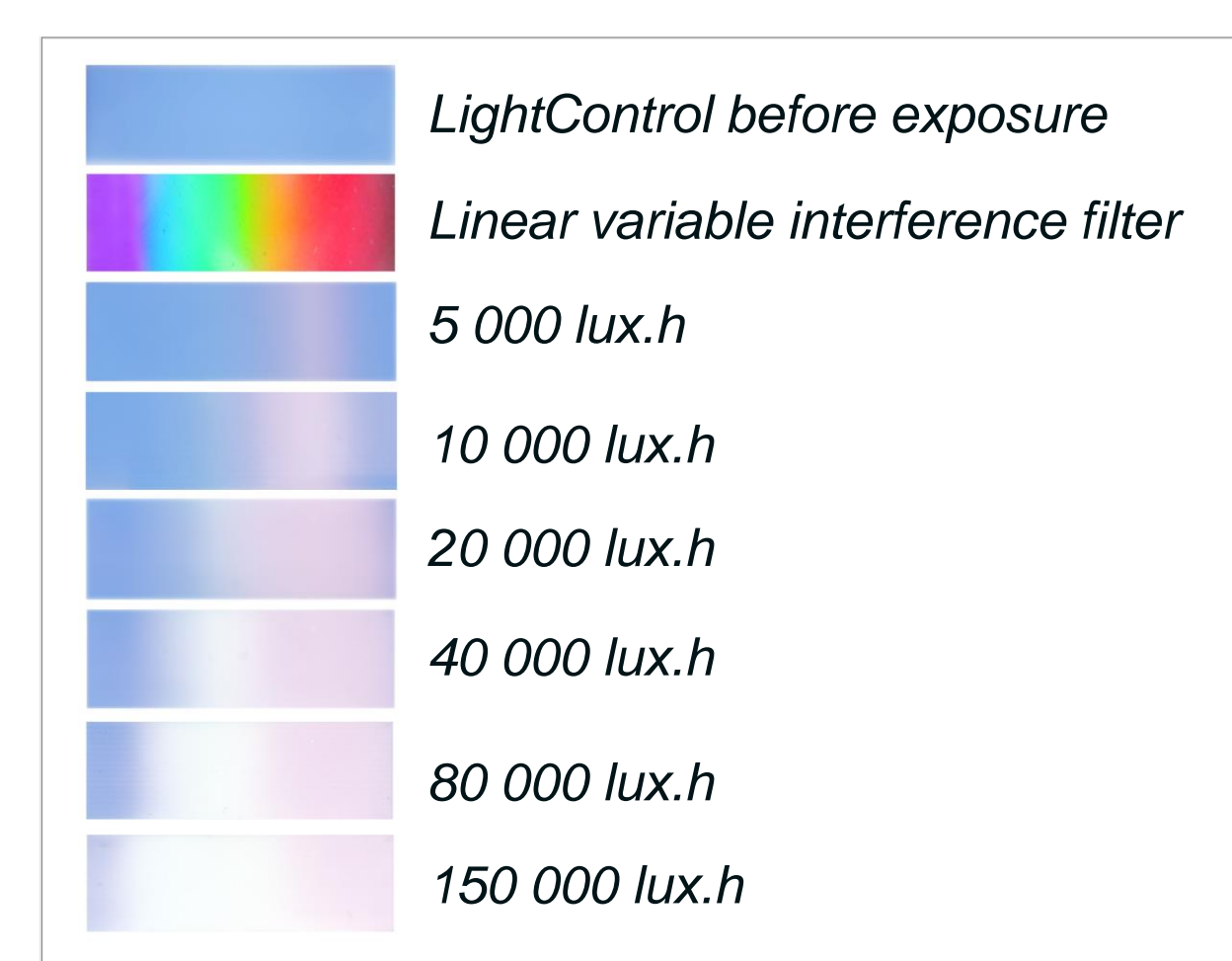


Figure 3a

Color change as a function of wavelength of LightControl aged under HMI light source and a linear variable interference filter

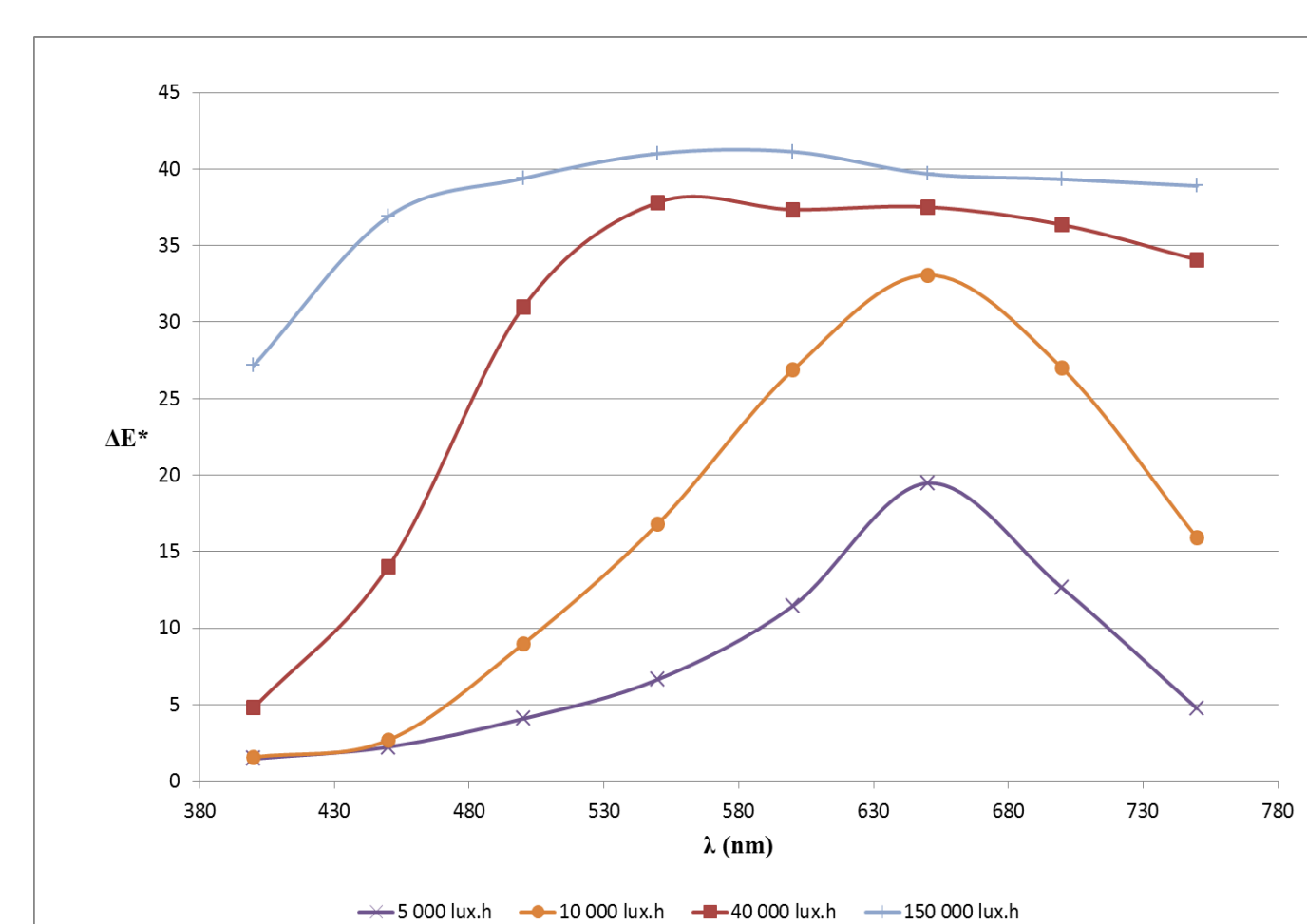


Figure 3b

Conclusion

Thanks to an inkjet printer and an adaptated formulation, we were able to produce a non toxic light dosimeter, with an accurate quality control. LightControl is a convenient monitoring system for short term exhibition to assess lighting condition between 5 and 200 klux.hours, which matches museum recommandations for the most light sensitive objects.

References

- ¹ Luminous exposure values from Appendix 8a, p. 138 of : J. Tétreault, *Airborne Pollutants in Museums, Galleries and Archives: Risk Assessment, Control Strategies and Preservation Management*, Canadian Conservation Institute, Ottawa, 2003.
- ² Patent US 6,633, 374 B1
- ³ Dupont A-L., Cucci C., Loisiel C., Bacci M., Lavédrine B., *Development of LightCheck® ultra: a novel dosimeter for monitoring lighting conditions of highly photosensitive artefacts in museums*, Studies in conservation, vol. 53, 2008, p. 49-72.
- ⁴ S. F. Pond, *Inkjet Technology and product development strategies*, Torrey Pines Research, 2000.