

Microscopic devices for UV-Light, important tools in biological and medical research

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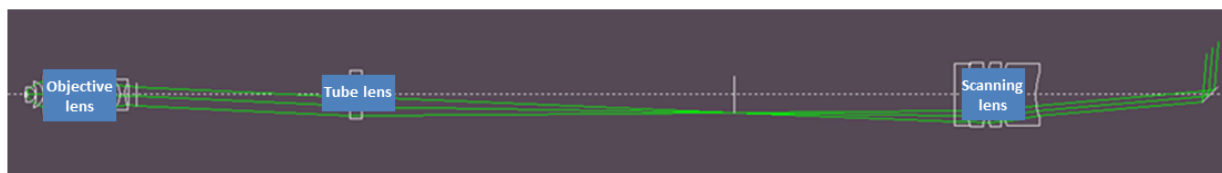
Summary: Modern microscopic techniques are important in the biological and medical research to understand and treat diseases like Cancer, Dementia or Depression. It is shown that an optical system without any lead glass would not have a sufficient transmission in the ultraviolet wavelength range (UV). Microscopes without a sufficient performance at UV are a critical limitation for broad range of methods.

Microscopic devices are used in many different research fields. Light with short wavelengths is used for imaging and manipulation purposes in biological and medical research. Especially the ultraviolet light as 355nm or 405nm is important in the modern microscopy. This overview should show typical methods, fields of research and the used wavelengths:

Method	Prescription	Field of research / Diseases	Wavelength
Laser capture micro dissection	Identification and isolation of cells from larger tissue microenvironment ⁴	Cancer ^{1,5,6,7,8} , Alzheimer ²	348nm, 355nm
Uncaging / optogenetic	protein that is activated in the presence of a stimulating light source ^{3,9,10,11}	Parkinson's disease, Epilepsy, Depression	350..530nm

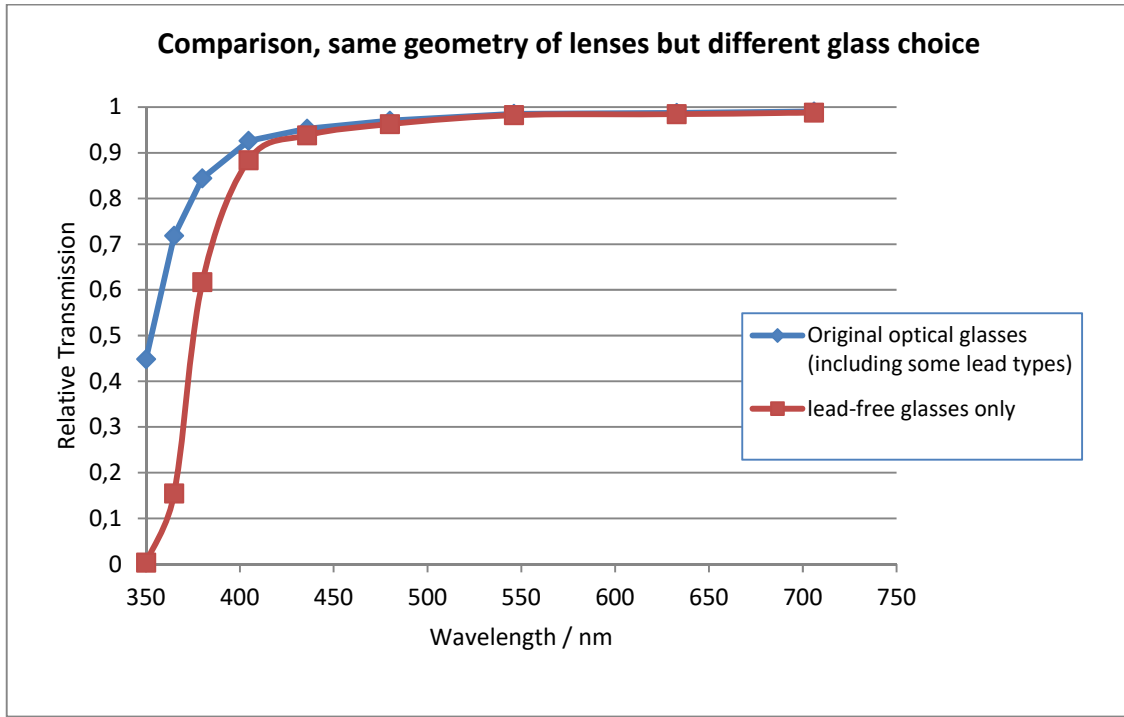
The wavelength is an important parameter for the design of a microscopic device. The optical system has to have a good transmission and a good image quality. Transmission is the value to describe which amount of light we can expect after passing the system. The image quality means how small are the optical aberrations which would limit the optical resolution of a system.

A typical microscopic device consists of an objective, a tube lens and a scanning lens.



Lenses are made of optical glasses. The transmission is depending of the wavelength. It is different for different optical glasses. The chemical elements are determining the characteristic. Lead glasses in comparison with optical glasses without lead have a much higher transmission in the ultraviolet wavelength range (e.g. 350...400nm).

To quantify the difference one optical system has been modified. Originally it is using lead containing optical glasses (blue curve). The modified optical system is using optical glasses without lead (red).



The shown microscope system has originally a good transmission at 350...380nm. The value is between 0,45 and 0,85. Transmission drops dramatically after replacing the lead glass types. At 350nm the transmission drops from to 0,72 (72%) down to 0,15(15%). At 350nm we would have a transmission less than 0,01 (<1%). These transmission values are not sufficient. The mentioned microscopic techniques would not work with such a system.

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- 4 N. V. Kosheleva^{1,2,*}, I. V. Ilina³, I. M. Zurina¹, A. E. Roskova², A. A. Gorkun¹, A. V. Ovchinnikov³, M. B. Agranat³ and I. N. Saburina^{1,4} Laser-based technique for controlled damage of mesenchymal cell spheroids: a first step in studying reparation in vitro. *Biology Open* (2016) 5, 993-1000 doi:10.1242/bio.017145
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- 9 Tian J, Tu C, Liang Y, Zhou J, Ye X. Study of laser uncaging induced morphological alteration of rat cortical neurites using atomic force microscopy. Journal of neuroscience methods, 2015 - Elsevier
- 10 A M Walter, R Müller, B Tawfik, K DB Wierda, P S Pinheiro, A Nadler, A W McCarthy, I Ziomkiewicz, M Kruse, G Reither, J Rettig, M Lehmann, V Haucke, B Hille, C Schultz, J B Sørensen. Phosphatidylinositol 4,5-bisphosphate optical uncaging potentiates exocytosis. - Elife, 2017 - cdn.elifesciences.org
- 11 J Y Chatton . Ionic Homeostasis in Glia: A Fluorescence Microscopy Approach. - Reference Module in Biomedical Sciences, 2015 - serval.unil.cha-

Appendix 1: 68 papers which describe research using Laser Capture Micro Dissection in detail. Most of them are related to cancer

Appendix 2: additional 7 papers published 2015..2019. Most of them are related to cancer.