New overwidefield microobjectives.

Frolov. D.N. *, PhD, Frolov A.D. **,

* Firm "Focus", St.-Petersburg

** Saint-Petersburg State University of Information Technologies, Mechanics and Optics

Phone: +7(921) 748-02-12, Fax: +7(812) 590-82-83, E-mail: fronda@list.ru

Abstract: The results of optical design of lenses for optical microscopes, with a linear field in the intermediate plane of about 50mm. These microscopes can have full-size digital image receiver. Lenses are fully satisfy the requirements of the linear field, the correction of aberrations. An additional feature of these lenses is increased free tool segment before the first (front) lens. Lenses are designed for an infinite length of the optical tube (additional lens 200mm), height 90mm lens.

1. Introduction

The presence of various methods of microscopic research requires the development of a wide range of elements of the optical element base light microscopes. It is known that in the light microscope a major role in shaping the image has its main optical system, consisting of a lens and eyepiece. In this lens, having the most advanced optical correction is the most important element in this scheme because of its numerical aperture, the nature and degree of correction of aberrations depends on the resolving power and image quality on the microscope.

The widespread use and the main development in modern microscopes have lens elements of optical element base microscopes because of its universality, constructive possibilities for standardization for use in various types of microscopes.

Today the development microobjectives is on the way more informative. It is connected with the main technical parameters of lenses, and with the quality of the images they created. Ongoing search is on for the best (for those or other kinds of research on the microscope), rational design, developed and used new optical materials, improved techniques for optical calculation and design in general.

When analyzing the main trends of the optical element base of modern microscopes, it turns out that they fully reflect the main trends in the development of microscopy. These include increasing the resolving power and intensity, an increase in a linear field in reaching an increasingly high degree of aberration correction across the field, expanding the spectral range of investigations using the microscope. For the most complicated microscopic studies, including using digital image receiver system is required, allowing to obtain a flat field images, with apochromatic correction of aberrations throughout the linear field. In [1] shows the results of theoretical and practical research on the creation of Russia microobjectives new generation, most of which implements the standard method of micro-studies.

2. Increased informativeness of the light microscope

Today the developers of the optical elements of the element base microscopes focus their efforts on the solution of optical problems that increase the information content of systems.

The parameter of the linear increase of the field becomes a major in the design of modern light microscopes, when the possibility of review of a large linear field with high information content can increase productivity, optimize the process of microscopy. This applies particularly to the microscope, which is required to obtain the projection of images on the digital receiver of high resolution (large format). Figure 1 illustrates the motivation to develop new lenses provide the linear field in the image plane is about 50mm, which is approximately twice that achieved in the most perfect modern microscopes. The trend towards improvement of aberration correction across the field (reduction of residual curvature, astigmatism and other aberrations in the image object) is observed in all classes microobjectives.

3. Design elements of the optical element base of modern light microscope

The process of designing a modern microscope is the construction of a multilevel system combining elements of the optical element base with known marker and aberration properties. Used modular building optical systems of the individual elements (nodes). Chief among these nodes in the microscope is the lens. It is believed that microobjectives must be standardized, and their technical and other specifications must conform to a fairly large number of formal features. For example, the calculation microobjectives to "infinity", the observance telecentric ray path, to ensure the alignment parameters of input and output pupils, the constancy of their position in all the selected sets of lenses, parfokal, paracentric lenses [2] and others. All this allows to formalize the requirements for the

implementation of the standard techniques of micro-studies on the light microscope.

Table 1 shows the specifications and optical circuits microobjectives reflected light, which are intended for use in devices of "non-destructive testing, optical metallographic microscope. Objects microscopy "reflection" can be low-contrast and, conversely, a high-contrast, black-and-white, multicolored, phase, anisotropic, and others.

Specific studies in reflected light imposes its demands to the optical systems of lenses, primarily providing a flat field image of the object and the absence of scattered light. Methods of computer microscopy projection images on a digital receiver dictate additional requirements for the aberration correction lens reflected light, correcting astigmatism and distortion.

The proposed set of lenses with the concept of extra-linear field. The kit lens is implementing the most advanced to date technology of optical calculation and design, take into account the limited possibilities of modern optical and assembly industries. It was possible to obtain optical lens design, in which both realized at once three basic parameters of micro-optics. This long working distance, achieving planapohromatic aberration correction, extra long linear field. Figure 2 illustrates the characteristics of the current image quality of the lens 100h0.75 LLD.

4. Conclusion

In the near future we expect rapid development of electronics, the emergence of various visualization systems, digital microscopes and microscope systems. To ensure progress requires constant improvement of the element base microscopes. The quality of research is constantly improving, expanding the scope of research, new techniques. Table 3 presents the main technical characteristics and the fundamental optical schemes proposed over Widefield microobjectives.

References

1. D. Frolov. Synthesis of optical systems of lens microobjectives Journal of Optical Technology, Volume 69, № 9, 2002, p. 16-20
2. D.N. Frolov, R.M. Raguzin, V.A. Zverev optical system of a modern microscope, Journal of Optical Technology, Volume 69, № 9, 2002, p. 11-15

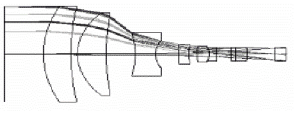
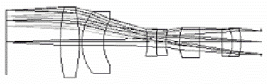
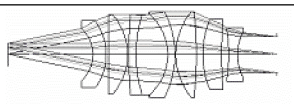
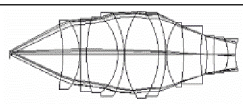
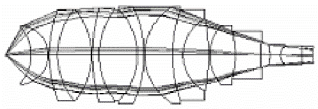
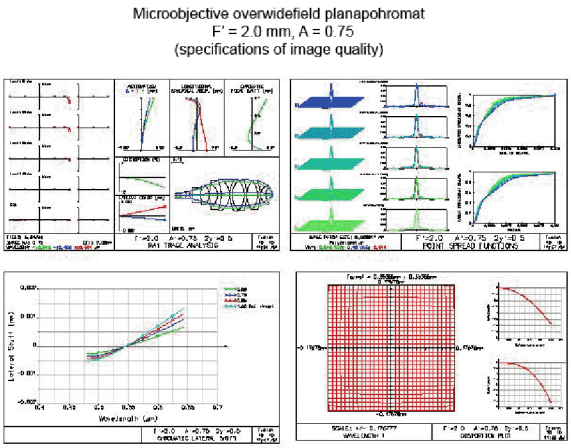
Specifications		Principal optical scheme
Magnification x aperture, Type of correction	Free working distance, mm	
height 95mm, infinity tube length, F'tl=200mm, 2y'≈50mm		
1) 1x0.015 planapochromat	2.0	
2) 2x0.04 LLD planapochromat	20.0	
3) 5x0.12 planapochromat	21.2	
4) 10x0.20 planapochromat	19.0*	
5) 20x0.40 LD planapochromat	18.6*	
6) 50x0.50 LLD 7)100x0.75 LLD planapochromat	14.8* 6.0*	
* taking into account the deflection of the front lens microscope objective		

Table 1. New overwidefield microobjectives



Pic. 1. Specifications of microobjective image quality F'=2.0mm, A=0.75LLD