Optical design of CCF PlanApo microobjectives 50mm observation and super long working distance

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Abstract. The main difference is a significant expansion of the linear field, which reaches 50 mm in the image plane. However, in this case, a planapochromatic correction must be achieved for the usual visible spectral range. Such a parameter of objectives, like over large working distances – is an additional advantage.

1. Introduction. Today, the optics of the microscope and objectives are developing along the path of increasing informativeness. This process depends, first of all, on the main technical parameters of objectives, the quality of the images they create, and the degree of aberration correction. Constant search for optimal designs of objectives continues. Methods of designing, developing and using new optical materials are being improved. The process of optical design and design of mechanical structures is improving.

2. Optical designs of different objectives.
The first group is the objectives of low linear magnifications (1x, 2x, 5x), the designs of which are close to the designs of classical or modernized photographic objectives.

The second group is the objectives of medium magnification (10x and 20x), where a strong reversive component is already used at the end of the optical circuit of the objective.

Figure 1. Images of high magnifications objectives

The third group of objectives are 50x and 100x, which have more complex optical circuits.

The fourth group is objectives with ultra-high values of linear magnifications (150x, 200x, 250x, 500x). The concept of building these objectives is the same; however, objectives of 250x and 500x have a three-glued component in their composition, which makes them more hard for manufacturing. Here, too, to increase the working distance of the objective, a strong reverse component is used, which is the last in the circuit.

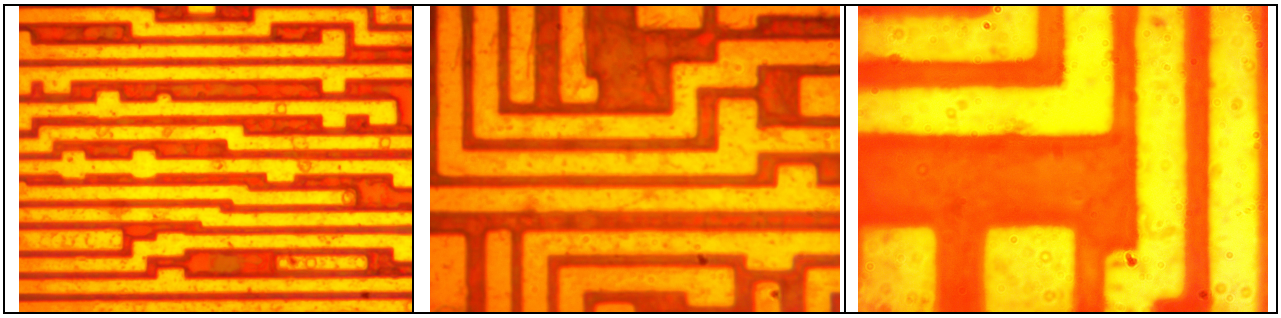


Figure 2. Pictures of objects using of 150x, 250x and 500x objectives.

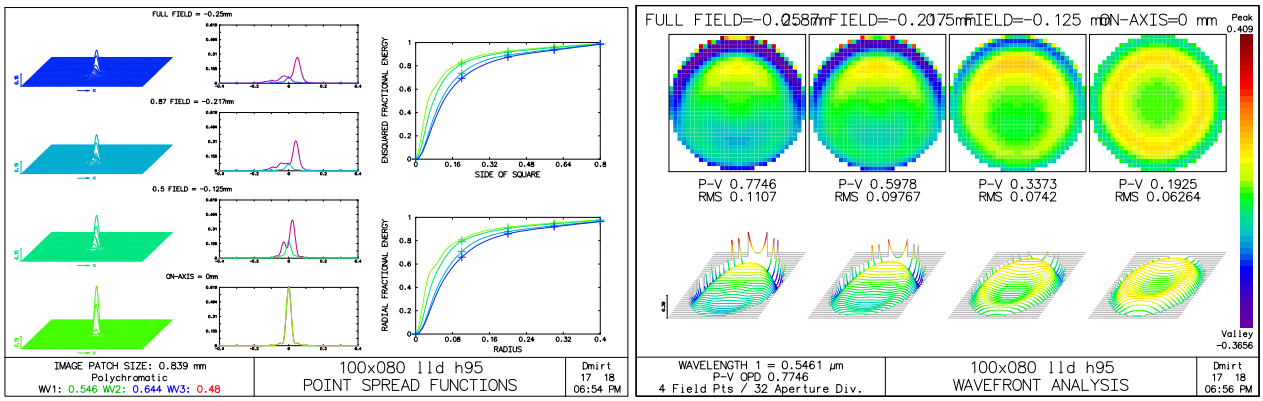
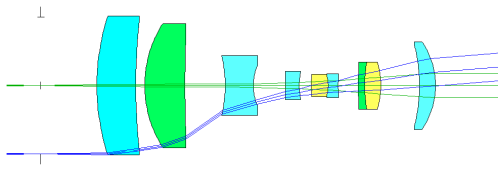
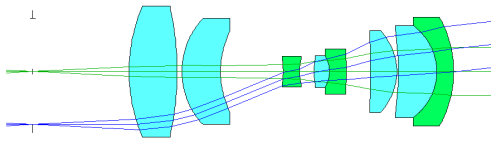
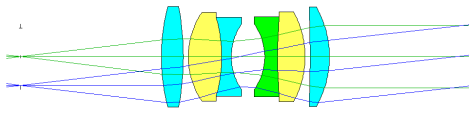
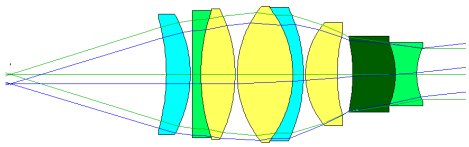
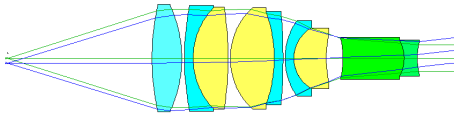
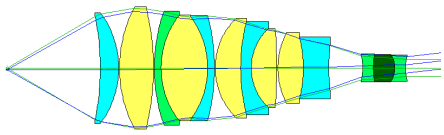
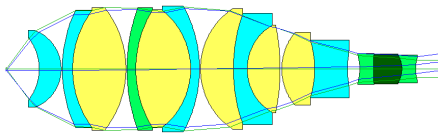
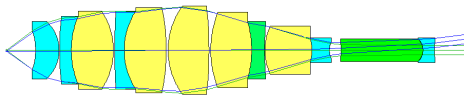
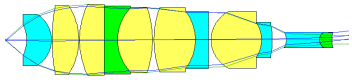


Figure 3. Aberration correction graphs for objective 100x / 0.80

Table 1. Main technical parameters and the basic optical layouts of the objectives.

Magnification	NA	WD (mm)	R (µm)	DF (µm)	FOV on object (mm)	FOV on image (mm)	The principal optical layout
1x	0.015	14	22	148	34	34	
2x	0.05	20	6.7	133	23	46	
5x	0.12	22	2.7	23	10	50	
10x	0.30	34	1.1	3.7	4.6	46	
20x	0.30	33	1.1	3.7	2.5	50	
50x	0.50	18.5	0.67	1.33	1.0	50	
100x	0.80	4.0	0.42	0.52	0.5	50	
150x	0.60	4.2	0.56	0.93	0.33	50	
200x	0.65	2.0	0.51	0.79	0.25	50	
250x	0.70	2.0	0.48	0.68	0.2	50	
500x	0.75	1.6	0.44	0.59	0.1	50	

3. CONCLUSION. Optical design of such objectives for the microscope as CCF PlanApo microobjectives 50 mm observation and super long working distance is a multi parametric task.

It is necessary .to take into account not only the basic principles of ray transmission and imaging, but also technological and consumer aspects in mechanical design and during the manufacture of the objectives