

# Special Features of Functioning of the Optical Channel of a Scanning Optical Microscope for Cryobiology and Cryomedicine

Bogdana Lubinecka, Anatoliy Pedan

**Abstract** - Is analyzed work of a scanning optical microscope, which magnification reaches initial values of electronic raster microscopes, at research of biological microobjects cryobiology and cryomedicine at a cellular level. Circuits of optical channels for working on show-through and reflection, and also microscopic cryostate for deep cooling are offered on the basis of thermoelectric modules and thermal pipes.

**Key words** - Scanning optical microscopy, cryobiology, thermoelectric modules, thermal pipes.

## I. INTRODUCTION

As against microscopic researches in biology microscopic researches in cryobiology become complicated presence of a cycle cooling - heating. At use of a base design of a microscope reception on its subject table of the set low temperature (at least up to  $-100^{\circ}\text{C}$ ) and long time its maintenance without use of liquid nitrogen is a difficult technical problem. It is necessary to modernize the optical channel of a microscope in a zone directly adjoining to the cooled preparation. It is especially important to provide absence of condensation of atmospheric moisture on optical elements of the channel, keeping thus the set temperature of a preparation. It is necessary to provide also factors of magnification in a microscope which messages of research at a cellular level allow. Now for research of objects at a cellular level at low temperatures the electronic raster microscopy is used, however, it is impossible to take advantage of it at long researches of alive biological microobjects.

## II. SPECIAL FEATURES OF FUNCTIONING OF THE OPTICAL CHANNEL

Researches of alive biological microobjects at a cellular level can be realized by a scanning optical microscope on the basis of electron ray tube (CRT). Thus the biological object is in conditions of existence natural to it.

Use microscopic objectives of the big magnification at research of cells in cryobiology would lead to their cooling with all negative consequences, such as termieoptical aberration of objectives, condensation of an atmospheric moisture, infringement of a temperature mode at change of scale of magnification by replacement of objectives.

The design of a microscope is chosen in view of its work in reflected light with use of low temperatures, submitted on fig. 1.

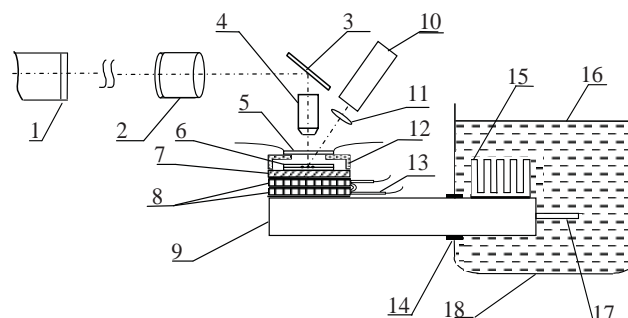


Fig. 1 - The circuit of a scanning optical microscope with a cooler of a preparation at work on reflection:

- 1 - CRT; 2 - 1<sup>st</sup> objective; 3 - mirror; 4 - 2<sup>nd</sup> long-focus objective;
- 5 - protective glass with warm up; 6 - preparation with cover glass;
- 7 - cooler; 8 - thermoelectric modules; 9 - thermal pipe;
- 10 - photoelectronic multiplier; 11 - condenser; 12 - hermetic box;
- 13 - output of modules; 14 - sealant; 15 - radiator; 16 - water;
- 17 - exhaust tube; 18 - vessel

The optical channel of a microscope with long-focus objectives, located outside a zone of low temperatures, realizes a way of two-level consecutive reduction with the intermediate virtual image, which is widely used in a photolithography.

Adjustable cooling of a preparation (up to  $-110^{\circ}\text{C}$ ) is carried out by elements Peltie's, removal and dispersion of heat - a thermal pipe and an absorbing liquid, which is periodically replaced. Working liquid of a thermal pipe it is chosen Freon 11, which temperature of boiling ( $+23,7^{\circ}\text{C}$ ) lays above temperatures of a water highway.

At wide practical use microscopic researches on show-through with application of low temperatures it is expedient to weaken some requirements to resolution, having allowed cooling of an objective and low temperature immersion liquid level with cooling of a preparation. Thus thermoelectric module and a thermal pipe should contain through apertures for passage of a light stream.

## III. CONCLUSION

The chosen designs of an optical part of a scanning optical microscope in view of its work with application of low temperatures provide achievements of the basic technical requirements to a microscope at the decision of problems cryobiology and cryomedicine - high resolution and a controllable temperature mode in the field of ultra low temperatures..

*Bogdana Lubinecka, Anatoliy Pedan* - Lviv Polytechnic National University, S. Bandery Str., 12, Lviv, 79013, UKRAINE, E-mail: shkliarskyi @ polynet.lviv.ua