Analysis of the Peculiarities of Using Multielement Photodetector Devices for Registration of Infrared Spectra

Nikita I. Lysenko[1,2], Vladimir G. Polovinkin[1,2]
[1]A.V. Rzhanov Institute of Semiconductor Physics SB RAS, Novosibirsk, Russia
[2]Novosibirsk State Technical University, Novosibirsk, Russia

***Abstract*– Analysis of the main peculiarities of using multielement photodetector devices (MEPD) in the composition of an IR spectrograph with a diffraction grating monochromator. The following can be referred to such peculiarities: nonlinear wavelength distribution over a photodetector device, differences in geometrical shift of beams in a cryostat window and differences interference lengths for each beam. It is shown with an example of the concrete device that deviation from the linearity at MEPD edges in the operation wavelength range reaches the value of the wavelength range coming for two elements; the geometrical shift difference ±25 mm, the change of interference length being +3 and -4 mm.**

***Index Terms* – infrared spectroscopy, grating monochromator, multielement photodetector device, infrared spectrometer, infrared spectrum.**

I. INTRODUCTION

SOME PECULIARITIES can manifest themselves when using MEPDs for registration of IR spectra combined with a grating monochromator. MEPD registrates some spectral range at a fixed position of the monochromator grating. Registration of aditional spectra is carried out by a subsequent change of the grating turn angle. In overlapping the spectral ranges measured at different turn angles, noncoincidence of signal values for equal wavelengths is possible. Such example is given in Fig.1.

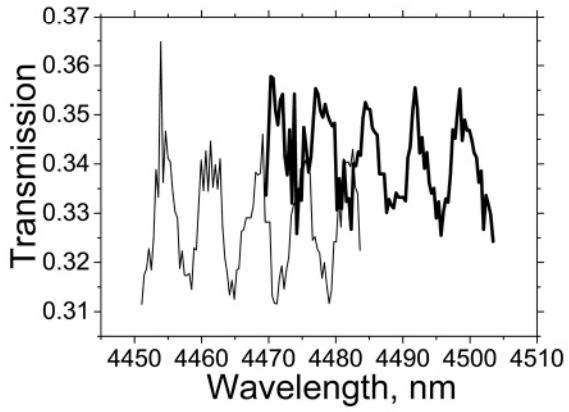

Fig. 1. Noncoincidence of signal values for equal wavelengths in overlapping the spectral ranges measured at different diffraction grating turn angles.

The reasons for such noncoincidence may be: first, nonlinear wavelength distribution over MEPD; second, the influence of cryostat window. Two optical phenomena proceed in a cryostat window: light refraction and interference.

The results of the calculations made for the IR-spectograph based on monochromator-spectrograph MS2004I of "SOLAR TII" enterprise (Belarus Republic, Minsk) and a hybrid microcircuit of InSb-based linear type photodetector device 1×384 [1].

II. MONOCHROMATOR-SPECTROGRAPH

Monochromator-spectrograph MS2004I has the optical Czerny-Turner circuit (Fig. 2), in which different focal distances for collimator and chamber mirrors to eliminate the 'comma' effect. Three diffraction gratings with different periods for different wavelength ranges are used in the monochromator.

MEPD for the spectrometric module contains a single-row line of 384 MIS-capacitors with spacing 25 μm. Assisted with such detector, it is possible to record the spectrum for a short time (0.2 – 50 mc) in the near and middle IR radiation ranges (1-5 μm).

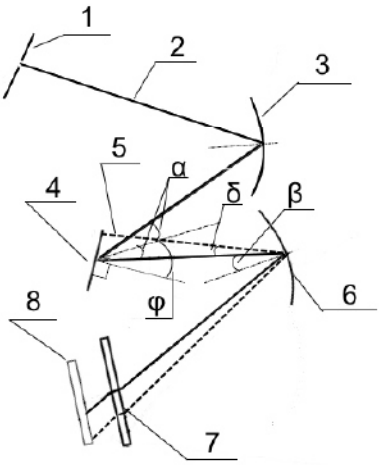

Fig. 2. Optical scheme of the monochromator-spectrograph: 1 is input slit, 2 is central beam way, 3 is collimating (input) mirror, 4 is diffraction grating, 5 is beam way with a wavelength shorter than the central, 6is camera (output) mirror, 7 is cryostat window, 8 is MEPD.