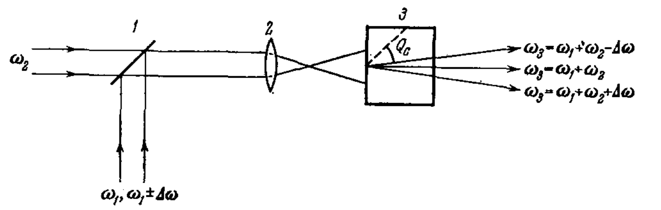

FIG. 2. Diagram of nonlinear spectrograph: 1) plate of glass (silicon), 2) lens, 3) nonlinear crystal.

interesting possibility, pointed out by N. G. Basov, is uncovered by nonlinear frequency conversion in spectroscopic procedures. If the slit of a spectrograph with a spectrum picture in the IR band is transformed into the visible band, then it becomes possible to do this simultaneously for an appreciable section of the spectrum and with high resolution. It is possible to utilize the dispersion characteristics of the crystal in such a way that the resolution in the direction perpendicular to the slit can be greatly increased at the cost of decreasing the resolution along the slit.

The functions of two instruments, the IR spectrograph and the frequency converter, can be combined in a single scheme of a nonlinear spectrograph. Such a scheme (Fig. 2) was proposed at the Moscow University and independently at the State Optical Institute. Nonlinear spectrographs can have a higher resolution and permit spectroscopic investigations of rapid processes.

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K. S. Mustafin and V. A. Seleznev. Methods of Increasing the Sensitivity of Holographic Interferometry.

Holographic interferometry is finding ever expanding and successful applications in various investigations. It is therefore of interest to develop methods of increasing the sensitivity of holographic interferometry. This is the subject of a number of papers[1-4]. The authors consider three methods of increasing the sensitivity of interferometric research on optical inhomogeneities of transparent objects by holography.

1. Three-color holographic interferometry. The method is based on incoherent superposition of two interference patterns with wavelengths λ_1 and λ_2 for the same inhomogeneity, and observing the resultant moire pattern. To this end, a comparison wave front is recorded on the hologram using one wavelength λ_0. This hologram is then illuminated with both an object beam and a reference beam having respective wavelengths λ_1 and λ_2, and the moire pattern is observed on behind the hologram. Two cases are then possible:

a) The finite-width interference patterns have opposite shifts, owing to the presence of the investigated inhomogeneity in the interference patterns with λ_1 and λ_2. In this case the moire pattern is identical with the interference pattern obtained at a wavelength $\lambda_{eff} = \lambda_1\lambda_2/(\lambda_1 + \lambda_2)$, i.e., at the sensitivity of the method is approximately doubled. If the condition $\lambda_0 = 2\lambda_{eff}$ is satisfied, then the imperfections of the optical systems do not affect the moire pattern.

b) The fringes in the interference patterns with λ_1 and λ_2 are shifted in the same direction. In this case the moire pattern is identical with the interference pattern observed with a wavelength $\lambda_{eff} = \lambda_1\lambda_2/(\lambda_1 - \lambda_2)$. This procedure may be useful where an appreciable decrease of the sensitivity of the interferometry is required, with a density jump for the identification of the fringes on both sides of the jump boundary. This method makes it possible to obtain an interference pattern of either increased or decreased sensitivity in a real time scale.

2. Three-beam holographic interferometry. The method is based on obtaining an interference pattern of an object wave with two identical comparison waves. To this end, for example, one registers on the hologram an object wave at a holography angle α_0, and two comparison waves at angles α_1 and α_2, such that $\alpha_1 < \alpha_0 < \alpha_0 < \alpha_2$ or $\alpha_2 < \alpha_0 < \alpha_1$. Under these conditions, the interference pattern obtained with the aid of such a hologram has double the sensitivity. The imperfections of the optical system are eliminated. This method can also be used to obtain interference patterns in a real time scale. To obtain a sharp image of the investigated object it is desirable to use holography of the focused image of the object.

3. Use of nonlinear effects in holography. The method is based on the transformation of the wave front when it is reconstructed from a hologram in a higher order of diffraction. The wave front from the investigated object is registered on the hologram under conditions that are known to be nonlinear. Then the hologram is illuminated with two reference waves so as to obtain an interference between the waves, restored in the n-th and m-th orders of diffraction. This increases the sensitivity by n + m times. The possibility is demonstrated of using nonlinear effects also in the method where the interference patterns are obtained by superposition of two holograms, on which the comparison wave front and the object wave front are registered separately. The influence of the aberrations of the holograms on the obtained interference pattern, using higher orders of diffraction, is considered. It is shown that when weak inhomogeneities are used the aberrations can be neglected if the holography and restoration are effected by plane waves.

By way of illustrations, interference patterns of transparent inhomogeneities, with increased sensitivity, were demonstrated.

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