NANOFABRICATION AND DIFFRACTIVE AND MICROREFRACTIVE OPTICS ELEMENT APPLICATIONS IN COMPACT SENSOR SYSTEMS

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ABSTRACT

The development of dynamical surface of viscous liquid with electrical charge is researched in the periodical restoring process of spatial deformation type crater. The possibility of obtaining of optical elements on PTPC is indicated which combines the different physical properties as the diffraction (diffusion) and the refraction (focusing). The investigation of evolution kinetic of periodical deformed dissipative structures of crater type deformation indicates the existence of optimal time of 0.1 - 9.9 s as the dependence of recording regime, the destroying of optical refractive elements does not take place during it. The experimental calculations indicate that the developing speed of dynamical surface refractive element can give the values of 100 micrometers per second in the transversal plane and 0.2 from the thickness of the visualizing layer in the normal plane. A mechanism of germination and a mechanism of multiplying exists in the process of apparition and development of dissipative structures. This assures the nanofabrication of diffractive elements as optical non homogenous in the real time of development of refractive element. The diffractive element as the form of nonhomogenizes - deformation of crater type appears in the limit intervals from 0.04 to 0.1 s.

1. INTRODUCTION

The problem of optical information recording at the technical installations which works upon the base of electrostatical image visualizing as a result of apparition and development of dissipative structures on the electrical charged free surface of a thin layer of viscous liquid or elastical viscous is necessary to be pointed out in the actual purposes of dielectrical and semiconductor physics. This is explained by the fact, that at the first sight the evident priority of high advanced technologies based upon the magnetical recording method which consists in the insurance of evident convenience in their using is out of concurrency. The large application of information registering on optical disks stimulates a major interest for the elaboration researches of nontraditional informational systems and operative methods of optical information registering. The development of informational systems included the photothermoplastic materials (PTPC) in the researching field due to the possibilities of conservation of spatial deformation for a long term (comparative with the save term of information on magnetical carriers). The phenomenon of apparition and development of created spatial dissipative structures by the electrical field on the electrical charged free surface of viscous liquid contains till now also the domains which are not researched. The principal difficult at the optical information registering represents the possibility of periodical restoring of free electrical charged surface into the deformed geometrical relief of dissipative structure with the hexagonal symmetry of crater type deformation on the perimeter of crater deformation type [1-4]. The problem of leading with the difficult manifestation of periodical deformed dissipative structures needs also the solving of using problem of leading parameter with the development – apparition process of deformed structures dimensions.

2. THE METHOD OF KINETIC INVESTIGATION AND DEVELOPMENT OF PERIODICAL DEFORMED SPATIAL DISSIPATIVE STRUCTURES OF CRATER TYPE

The description of physical phenomena which follow the kinetic of development – apparition of spatial periodical deformed dissipative structures on the electrical charged free surface of thin viscous liquid layer needs the elaboration of the method and technical installation which allow the research of kinetic of development – apparition process of periodical spatial deformed structures on the electrical charged free surface in the real registering regime. The technical installation[3-7] for the visualizing of electrostatical images and the stocking into the computer memory of development – apparition process kinetic assures the concomitant research of thermoplastic substances masses removing in the transversal and normal plane and the modeling of dynamical surface development of visualizing layer in the real time scale registering. The development of spatial dimensions of dissipative structures contributes to the intense diffusion of light and the decreasing of incident light flux intensity. The separation of points at the computer after the principle white – black in the kinetic of development – apparition of dissipative structures can restores the dynamical surface

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development. The modeling of dynamical surface development of visualizing layer in the real time scale registering includes the separation of shock wave development of masses removing in the normal plane as a sum of black points h_n which appear at the display on the pointed out domain of the frame N:

$$h_N = \sum_{i=1}^{k_z} \sum_{j=1}^{k_x} n_{ij} \quad (1)$$

here N=1,2,3....the number of researched frame; n_{ij} - the position of point i in the row j; k – the total number of points in the row i; k – the total number of points from the column j. Also the expression can be proved which describes the development of dynamical surface in the relative units.

$$h'_N = \frac{1}{H} \sum_{i=1}^{k_z} \sum_{j=1}^{k_x} n_{ij} \quad (2)$$

here n_{ij} - the position of i point in the row j; $H = k_{zx}$ - the total number of points from the evidenced domain. The maximal number of black points i in the row j doesn't exceed the total number of points in the row j. In this way, the development speed of dynamical surface was also calculated, corresponding to the ratio of number variation of black points Δn which appears on the evidenced domain to the total number of points n on this domain:

$$v = \frac{1}{\alpha H}\left(\sum_{i=1}^{k_z} \sum_{j=1}^{k_x} n_{i,j} - h_{N-1} \right) \quad (3)$$

here $\alpha = N \cdot 0.04s$; $N = 1,2,3...$ the step of researched frame.

n_{ij} – the position of point i in the row j; H – the total number of points from the researched domain; h_{N-1} - the sum of black points in the precedent frame.

The development of dynamical surface, for the given gradation of frame can be represented graphically obtaining a family of curves. The family of curves generalizes the development of dynamical surface that can be represented as:

$$h_N^{I\Gamma} = \frac{\sum_{\Gamma=1}^{255} h_N^{\Gamma}}{\Gamma} \quad (4)$$

here Γ - the chosen gradation (between white and black).

The profile of deformation indicates a direct dependence on illumination. The dependence of shape curve which describes the development of dynamical surface in the real time scale registering, of illumination can be decreased if the parameter of correction of white – black gradation will be introduced. This paper presents the "optical compensation" of optical aberrations by the following procedure:

$$I_j = \sum_{i=1}^{N_x} \begin{cases} = 1, for \Gamma_z \geq \Gamma_0; I_{j-1} = 1; j = j+1 \\ = 0, for \Gamma_z < \Gamma_0 \end{cases} \quad (5)$$

Here I_j – the light intensity of the point N_x in the row j, Γ_0 - the value of gradation which assures the optical compensation.

The optical compensation allows to model and verify the curves which describes the development of dynamical surface within limits $j = j+1$ and $j = j-1$. The quality of optical images of dynamical surface development process can be improved also by the optical compensation performed in the real time scale registering by the video camera at the illumination lower than $E = 0.33$ lx.

3. EXPERIMENTAL INVESTIGATIONS

Experimental investigations [3-6] indicates that he sensitizing of visualizing layer in the recording cell by preventive thermal treatment at the high temperature than the temperature of amorphous state and lower than the flowing