Small-Sized Holographic Devices With Polymer Based Reversible Recording Medium

Davidenko N.A.[a], Davidenko I.I. [a], Pavlov V.A. [a], Studzinsky S.L. [a], Chuprina N.G. [a], Mokrinskaya E.V [a]., Kuranda N.N., Kostenko L.I.[b], Tonkopieva L.S.[a]

Kiev Taras Shevchenko National University

[b] *L.M.Litvinenko Institute of Physics-Organic Chemistry and Coal Fuel Chemistry NAS of Ukraine*

ndav@univ.kiev.ua

The principle of the photothermoplastic method of hologram recording as well as the general requirements for photothermoplastic holographic recording media based on photoconductive polymer films are considered. The holographic recording media obtained by authors based on carbazolyl- and ferrocenyl-containing oligomers doped with organic dyes are discussed Some examples of practical application of such media in holographic interferometry are demonstrated.

Introduction

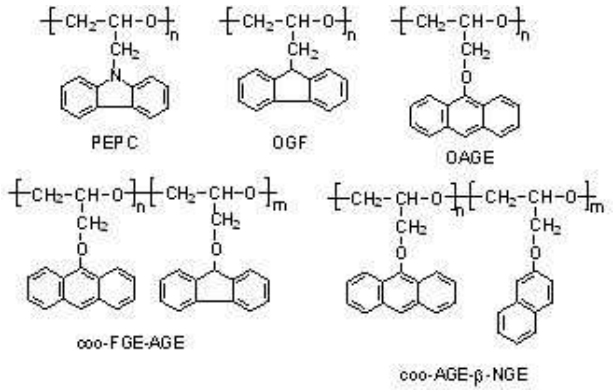
The information systems with low cost and high processing speed are preferable in energy saving technologies. Holographic and electro-magneto-optical light modulators are the important components of such systems. In these components storage, accumulation and processing of the optical information is accomplished in recording (photoactive) mediums. It can be used for optical data storing, protection of securities, in artistic holography, and seems adequate for holographic interferometry and nondestructive testing of industrial products. It provides high resolution and fast dry development of holograms without changing the position of the holographic recording medium (HRM). HRMs based on photoconductive polymer films (PCPF) as well the electronic devices to control their work are used in the photothermoplastic method of data recording [1].

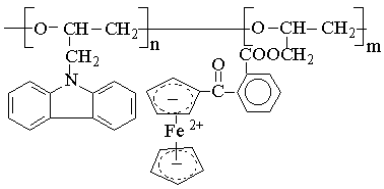
Experimental part

An important characteristic of HRMs is the selective sensitivity to a certain spectral interval. The selective HRM has the advantage that during hologram recording it is more protected from external lighting and hence can be used without special light-protection of the optical scheme. HRMs doped with organic dye have very high spectral selectivity which is determined by the position of the dye's long-wavelength absorption band.

In principle, a great deal of polymer binders with good flow properties can be used in photothermoplastic HRMs. But then, for photogeneration and transport of charge carriers, the additives with electron-donating and electron-acceptor properties should be introduced into PCPF. Therefore, it is more

convenient to use the polymers/oligomers in which such additives are chemically bound to the polymer chain [2-4] (see scheme below for examples).





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Discussed here HRMs can be used and are currently used for various practical applications. It was mentioned above that one of them is visual (art) holography. However, the HRMs based on PCPFs as well the electronic hardware to control their work are rather expensive compared with conventional holographic media. Therefore the considered HRMs can be most effectively used in special technical applications, which require fast registration of holograms without changing the position of HRM in space. Practical application of PCPF based HRMs are illustrated below by simple and visual examples.

Results and discussion

We have developed small-sized holographic interferometers [5] for scientific investigations. Our developed HRMs are used in these interferometers. Picture of the small-sized holographic device is shown in Fig.1. The samples of its using are shown in Fig.2 – 5.

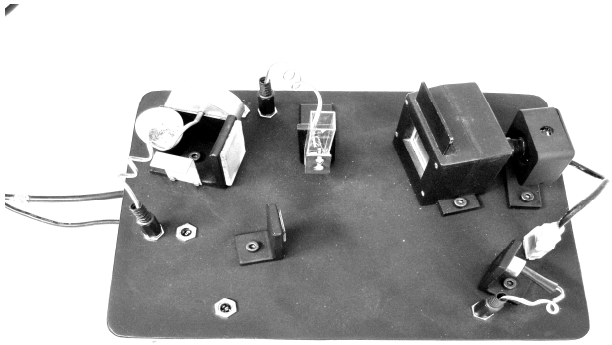


Fig.1. Small-sized holographic device.

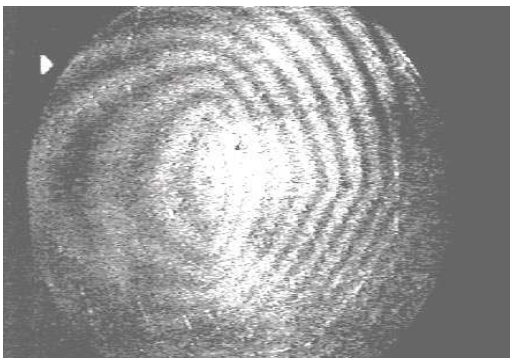


Рис.2. Interferogram of a flat metal plate with T-shaped incision in its opposite side.

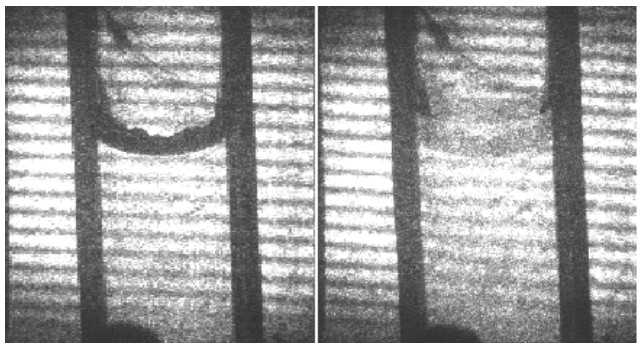


Рис.3. The image of the cell with water before (left) and after adding of the SiO_2 nanoparticles (right).

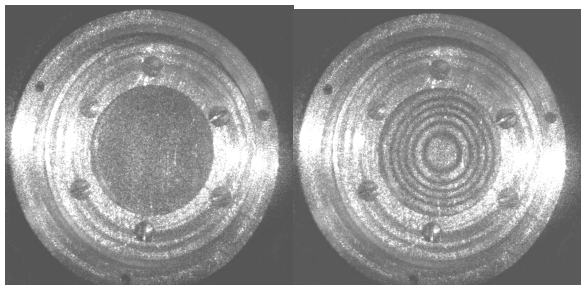


Рис.4. Image of the piezoelectric speaker before (left image) and when electrical voltage was applied (right image). Spatial frequency of interference fringes increases with increasing voltage. After turning off the voltage, interference fringes disappear immediately.

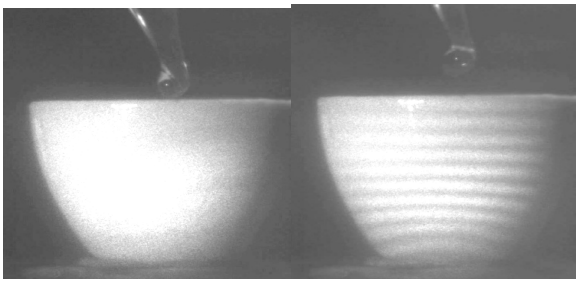


Рис.5. Images of the cup before (left) and immediately after placing some drops of hot water (right). At the right image bright and dark fringes appeared, they visualize changes in linear dimensions of the cup as a result of heat distribution in its walls. Over time, the interference fringes disappear indicating the leveling of cup temperature

Picture of small-sized holographic interferometer which was developed in cooperation with Swedish company AGELLIS is shown in Fig.6.

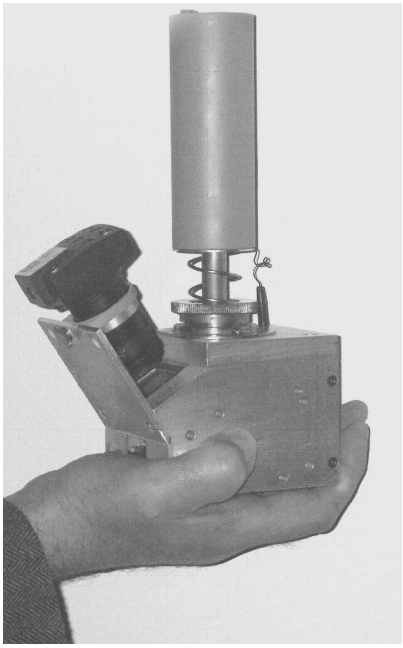
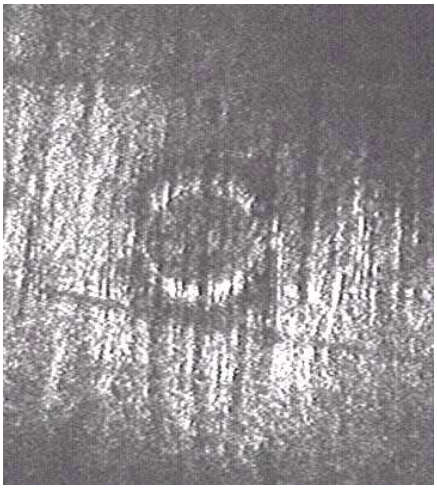


Рис.6. Small-sized holographic interferometer.

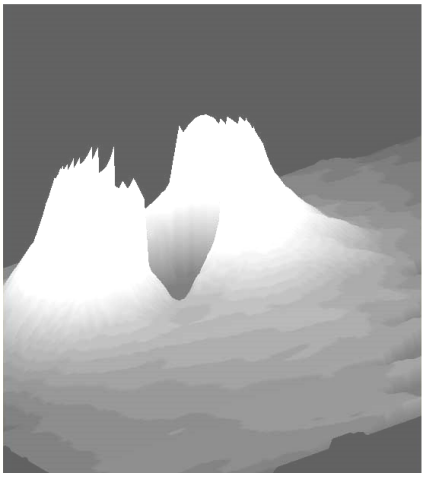
Small-sized holographic interferometer (SHI) is intended for qualitative and quantitative analysis of the fields of deformation of the object surface under influence of operational loading. SHI allows to carry out analysis of deformation in cases of mechanical and thermal influence, under loading of internal pressure. It also allows to reveal latent defects and residual stresses in units produced using composite materials. SHI set consists of the main modulus where optical scheme with holographic recording medium is placed, electronic controlling block, cable connecting the main modulus to electronic controlling block and PC, software. SHI differs from other known testing complexes where holographic interferometry technique is used by absence of necessity to place investigated object into the measuring scheme. The main modulus of SHI is places

onto the object surface. This feature allows to use SHI in uncomfortable "field" conditions.

The samples of SHI using are shown in Fig.7 a and 7 b.



a



b

Рис.7. Image of interferogram (a) and 3D-processing of the interferogram (b) of the small area of surface of aluminum plate after drilling of round cavity with drill diameter 1 mm at the depth 0.5 mm.

Conclusions

Developed HRMs possess satisfactory information characteristics for their employing in holographic interferometry. This fact is confirmed by practical application of these HRMs in the developed small-sized holographic interferometers.

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