Application of the digital holographic interference microscope for transparent thin solid films investigation

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Scientific and technical direction, connected with film production, is extensively developing and in many branches of modern industry occupies the leading position. Production of coatings, deposited on polymeric material surface, is an integral part of the direction.

Polymer goods with different coatings are used as functional components in electronic equipment production, as units of aviation and space apparatus. Coatings, aimed for plastic optical material surface protection, have found wide application.

During the technology improvement process there is the necessity of coating surface quality investigation.

For film coating quality and different surface defects investigation optical microscopes are widely used. But use of optical microscopes allows one to obtain only 2-D image of an object surface; direct qualitative measurements are impossible.

Application of microinterferometers for these purposes has some advantages due to the possibility of film thickness measurement. High accuracy of thickness measurement has been achieved for optically nontransparent coatings. But the known optical microinterferometers do not allow one to obtain good results for thickness measurements of transparent thin films (0.1 – 0.5 μm) on transparent substrates.

The problem of the 3D visualization of phase micro-objects was solved by combining holographic methods with the methods of computerized image processing [1, 2].

The first digital holographic interference microscope (DHIM), which makes it possible the real-time 3D imaging of phase micro-objects and the quantitative measurements of their parameters, has been created at the Laboratory of Holography of the V.N. Karazin Kharkov National University.

This work is devoted to the DHIM application for transparent thin solid films on transparent substrates investigation.

The DHIM consists of three main units: holographic microinteferometer, digital video camera and computer. A He-Ne laser with a wavelength of 0.63 μm serves as the radiation source. The interferograms of the micro-objects under study obtained using the holographic microinterferometer are recorded by the digital camera. The digital interferograms are computer processed using the mathematical algorithms that makes it possible to reconstruct the 3D images of micro-objects and to measure their geometrical parameters.

Used films were deposited by the vacuum-arc method, which is rather effective and universal. The process of AlN coating obtaining consists in Al vaporization and its condensation on polymer surface in the gas N_2 presence. Deposition was performed on the production installation «Bulat» in the National Scientific center «Kharkov Institute of Physics and Technology».

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On Figure 1 one can see the fragments of surfaces of AlN thin films deposited on acryl substrate with deposition defect (a) about 4 μm in diameter and artificially created surface damage (b). The films mean thicknesses is about 0.1 μm.

On Figure 2 one can see the fragments of surfaces of AlN thin films deposited on acryl substrate damaged under thermal (a) and UV-radiation influence (b). The films mean thicknesses is about 0.2 and 0.1 μm.

DHIM can be successfully used for transparent thin solid films surface quality control, thickness and film defects parameters measurements.

1. T.V. Tishko et al., J. of Opt. Tech., 72 (2005), p. 203.
2. D.N. Tishko et al., Opt. J., 76, №3 (2009), p. 40-43.

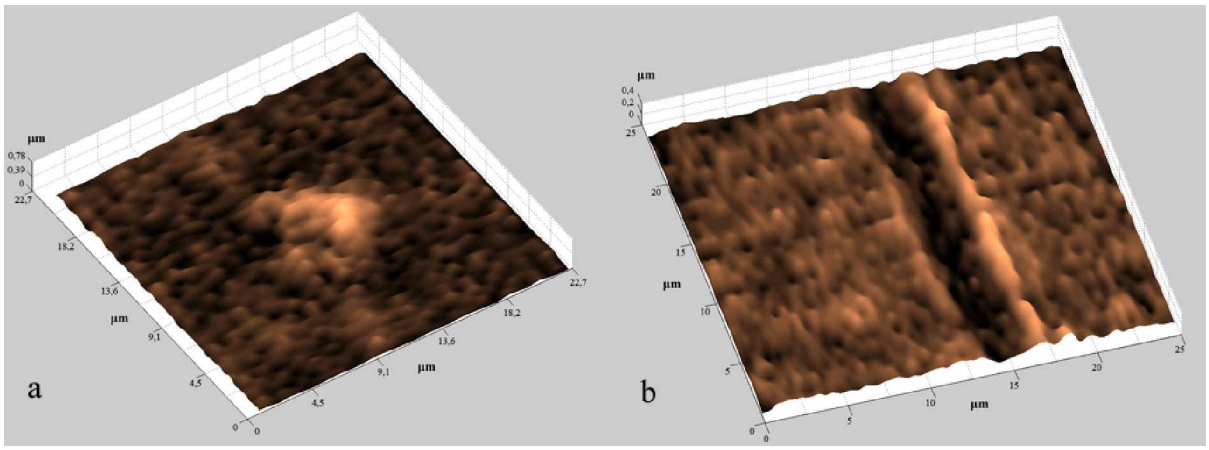

Figure 1. Fragments of surfaces of AlN thin films deposited on acryl substrate with deposition defect (a) about 4 μm in diameter and artificially created surface scratch (b). The films mean thicknesses is about 0.1 μm.

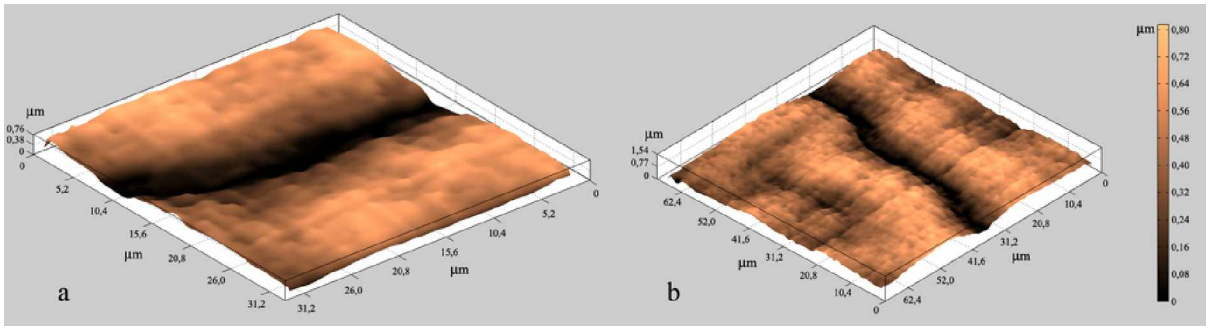

Figure 2. Fragments of surfaces of AlN thin films deposited on acryl substrate damaged under thermal (a) and UV-radiation (b) influence. The films mean thicknesses is about 0.2 and 0.1 μm.

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