Optical-electronic technologies in materials analysis

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ABSTRACT

It is proposed a new optical electronic approach for effective, simple and non expensive testing of the materials. An optical correlator is used for high speed features extraction, which characterize the distribution of the informational important elements in the crystallographic image. The digital "portrait" of the analyzed material is constructed which is compared with the set of the standard "portraits" on the base of which the level of the quality of the material is determined. The method permits to automate the process of the crystallographic images analyses and to increase the reliability of the results.

Keywords: analysis, correlator, image, feature, material, optical-electronic, system

1. INTRODUCTION

In the different countries from former Soviet Union, Europe etc a big part of market consists of falsified products such as medicines, spirits drinks etc. which are produced by no licensed companies. This influences negatively on the health of the population and on the State's budget. The financial circulation of the "black" market constitutes a sufficient part (up to 70%) of the State's budget, which represents the real treat for National security.

In these conditions the elaboration of the effective, simple and non expensive testing methods and systems for operative analyses of the materials is of a great importance.

Optical Pattern Recognition XVI, edited by David P. Casasent, Tien-Hsin Chao,
Proceedings of SPIE Vol. 5816 (SPIE, Bellingham, WA, 2005)
0277-786X/05/$15 doi: 10.1117/12.604321

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One of the perspective direction in the materials analysis is based on the examination of their crystallographic images[1]. The advantages of this approach are high sensitivity and comprehension, repetition and cheapness.

The known crystallographic methods[1-3] of materials testing are based on the analysis of the images by experts which do not permit in many cases to realize real time process. There were different attempts to automize the analysis of the crystallographic images[4]. But these approaches permitted only to determine the informative fields in the image for using in the experts decisions acceptance. Also, the disadvantage of these approaches consists in the low reliability of the results due to subjectivity in perception by different researchers of analyzed crystallographic images, which are characterized by high complexity. The experts' opinion in many cases depends on their qualification and experience.

We propose a new approach, which permits completely to automate the process of the crystallographic images analysis, to increase the reliability of the right decisions and the productivity of the materials' testing.

We suggest to use a special purpose optical electronic system for crystallographic images analysis. This system contains an optical processor for rapid extraction of the features from the crystallographic images, introduction of these features in the computer and their processing by special algorithms. An optical correlator is used as optical processor in the system, which permits to form the features with high speed (approximately 10^{15} bits/sec). This will decrease sufficiently the time of crystallographic images' analysis.

2. FORMATION OF THE CRYSTALLOGRAPHIC IMAGES

The crystallographic images can be produced by different methods[4]. One of them is based on the evaporation of a dissolvent from a bio liquid placed on a glass. The bio liquid represents the water solution of mineral substance with organic components such as sugar, proteins etc. For example, in medical diagnostics for obtaining the crystallographic images are used the blood, urine, salivary and lachrymal liquids, intestinal, stomach and pancreatic juices, cellular lymph etc.

Another method is based on introducing a fixed amount of a bio liquid into a solution of known material (usually cuprous chloride). At the process of evaporation are forming the crystallographic structures. The degree of changing of the obtained structure from a known structure may serve as the diagnostic feature.

As an example, the crystallographic images of some Moldavian cognacs are presented at fig.1. These images were produced as follows.

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