запасом пластичности, позволяющим деформировать их без отжига после взрыва на величину до 72 %. Пластическая деформация до 72 %, а также последующий отжиг при температуре 900-950 °С с выдержкой 30 мйн способствуют выравниванию микротвердости и микроструктуры по сечению стенки труб.

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THE APPLICATION OF THE CHEMOGRAPHY METHOD FOR CONSTRUCTING FIELDS OF GAS EMISSION FROM SPACE VEHICLE SURFACE

The topicality of the research related to the study of gas emission consists in the fact that gas emission and subsequent condensation occur unevenly, are determined by the presence of particular material on the surface of the spacecraft, and by the effect of space factors.

There are standards regulating the norms of the loss of material mass and the norms of the condensed phase, namely: ECSS-S-ST-00 (ECSS-S-ST-00-01 ECSS System – Glossary of terms; ECSS-Q-ST-10 Space product assurance – Product assurance management; ECSS-Q-ST-10-09 Space product assurance – Nonconformance control system) [1].

It should be noted that in these standards the attention is paid to the properties of the material, but the conditions for its use and the location of the spacecraft are not taken into account.

Traditionally, the method of cold deposition (condensation) of volatile substances released in vacuum, when heating samples of materials, is used to control gas emission and decide on the use of a specific material in the production of space vehicles [2].

To conduct the research, we used the VUP-5 camera with a special working insert that allows heating and cooling of the plates to a given temperature with an accuracy of 0.5 ^{0}C (Fig. 1). The temperature on a cold plate was regulated using Peltier elements, which allow controlling heat fluxes by changing the difference of potentials on semiconductors.

In the course of the research it was found that the surfaces themselves (even practically inert to chemical interactions) can give a chemographic effect due to certain features.

Figure 1 – Vacuum post VUP-5 with a special insert for testing materials for gas emission

In one case, this effect manifests itself as a result of the functioning of peculiar microvoltaic pairs (for example, in aluminum alloys), in other cases – as a result of defects in the crystal lattice or its deformation under the action of previously applied loads (Fig. 2).

a) b)

Figure 2 – Chemographic images:
a) the surfaces of a ceramic instrumental plate;
b) the surfaces of a hard-alloy element

An important point in the method of fixing reactions of ultra-low concentrations is its resolution.

To solve the issue of resolving power, we considered a sample with a microcrack, which was identified by the chemographic method.

The tests were carried out according to the standard method by installing the test materials in the appropriate bars (Fig. 3). However, the location of the heated and cooled bar was changed, tracking the intensity of deposition of volatile substances depending on the distance to the researched object along the unit vector. Next, the volatiles were deposited on silicon plates and control aluminum, chrome plates 0.14 mm thick. After the experiments the plates were weighed and the mass of the deposited material was calculated.

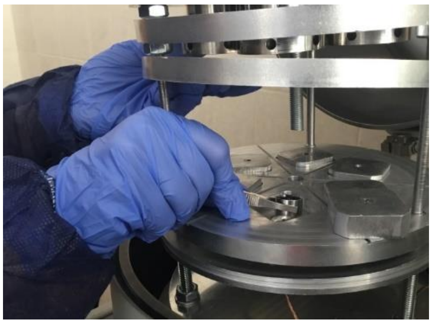

Figure 3 – Samples located in bars

The obtained imprints were scanned adjusting the actual size of the image and the image obtained on the computer raster, as well as assessing the amount of illumination of the deposition surface relative to a clean surface. The comparison of the characteristic areas of the image and the calculation of the intensity of the chemographic effect in black gradations over a 100-point scale were performed using original computer programs.

We found that with increasing distance the mass of condensed matter decreased significantly, which made it possible to construct gas emission fields for the researched sidewall surface of the satellite.

Considering the entire surface of the satellite, it is possible to construct histograms of gas emission for any planes, and using the principle of superposition of gas fields on adjacent elements, one can obtain the value of the expected concentration of active molecules for certain operating conditions.

We also additionally researched the maximum possible resolution of the method, which allows predicting the depth of damage to the layer by the revealed defects, based on a number of scribes made on the surface of the samples and measured from microelectronic SEM photos.

Thus, the use of the presented equipment and methods significantly clarifies the level of forecasting gas emission and condensation, and also enables direct modeling of these phenomena for various circuit designs and used materials.

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РАЗРАБОТКА ДОПОЛНИТЕЛЬНЫХ ЭЛЕМЕНТОВ ДЛЯ ЭЛЕКТРОННОГО УЧЕБНОГО КОМПЛЕКСА «КОМПЛЕКС УДТ ОВД» С ЦЕЛЬЮ ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ ПРАКТИЧЕСКОГО ОБУЧЕНИЯ АВИАЦИОННОГО ПЕРСОНАЛА СЛУЖБ УВД

Практическое обучение – часть учебного процесса, направленная на подготовку специалистов к будущей трудовой деятельности. Практическое обучение является неотъемлемой частью подготовки авиационного персонала служб УВД. Особенностями практического обучения авиационного персонала служб УВД являются: применение учебно-диспетчерских тренажеров, имитирующих реальную воздушную обстановку; моделирование различных ситуаций воздушной обстановки, позволяющее отработать все четыре метода эшелонирования воздушных судов (управление поступательной скоростью, управление вертикальной скоростью, вертикальное эшелонирование, векторение); отработка действий при аварийных ситуациях, таких как: отказ радиосвязи, пожар на борту воздушного судна, захват воздушного судна, неисправность шасси и т. д. отработка фразеологии радиообмена на двух