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EXPERIMENTAL STUDIES OF HYDROGEN-PALLADIUM INTERACTION IN THE A-REGION OF THE PD-H DIAGRAM

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My research work is aimed at conducting experiments and studying the behavior of materials in different conditions, which will help in solving problems with storage and obtaining hydrogen.

MATERIALS AND METHODOLOGY OF THE EXPERIMENT

A cantilever was installed in the hydrogen-vacuum installation, and one end was fixed in a holder so that the side of the cantilever was on top, which is covered with a copper film that does not allow hydrogen to pass through and does not affect the shape of the cantilever change. Next, the hydrogen pressure in the chamber was raised to the specified value and hydrogen saturation was carried out on one side of the cantilever made of pure palladium (99.99%), as a result, an α-PdHn alloy was obtained. After that, this alloy was kept in a hydrogen environment to equalize the hydrogen concentration along the cross section of the cantilever and to reduce the hydrogen-concentration stresses. As a result of such experiments, alloys with different hydrogen content from n= 0.0077 H/Pd to 0.017 H/Pd were obtained.

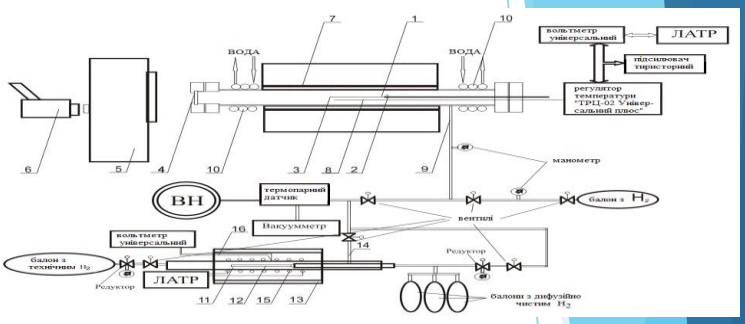
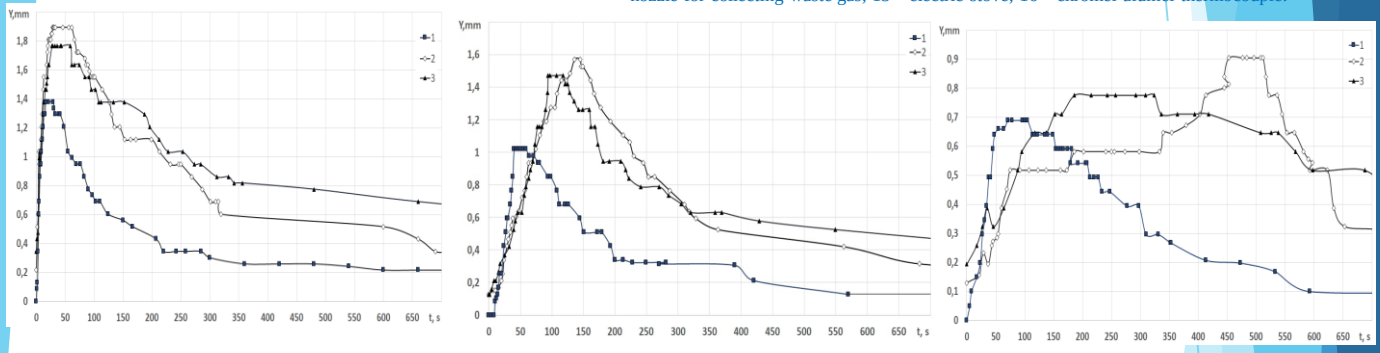


Fig. 1. The working chamber of the hydrogen-vacuum installation (HVI) and its connection with other units: 1 – sample; 2 – holder; 3 – free end of the sample; 4 – window; 5 – cathetometer; 6 – video camera; 7 – electric stove; 8 – chromel-alumel thermocouple; 9 – nozzle; 10 – refrigerators; 11 – palladium filter chamber; 12 – diffusion element; 13 – palladium filter camera body; 14 – nozzle for collecting waste gas; 15 – electric stove; 16 – chromel-alumel thermocouple.



1) of 0,01 MPa/s 2) of 2,0·10-4 MPa/s 3) of 4.8·10-5 MPa/s

Fig. 2. Time dependences (T= 150°C):of the cantilever deformation 1 - for pure palladium, 2 - for the α-PdH0.0077 alloy, 3 - for the α-PdH0.0177 alloy at a hydrogen inlet rate into the chamber :

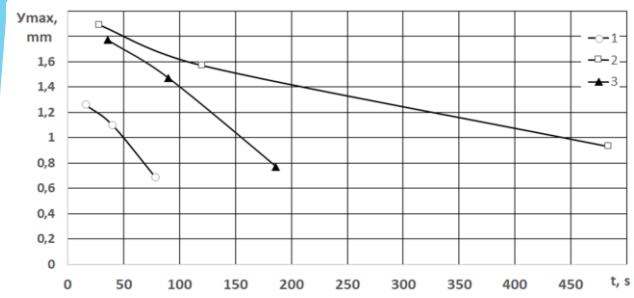


Fig. 3. Dependence of the maximum bending value on the time of reaching the maximum bending for 1, 2, 3 passes according to the results of experiments

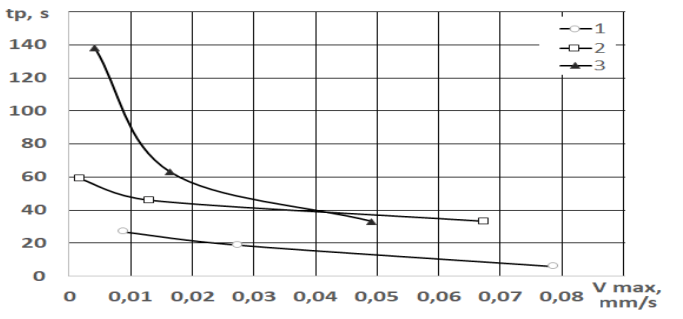


Fig. 4. Dependence of the platform during maximum bending on the speed of achieving maximum bending according to the results of 3 experiments (fig. 1-3) for three charges: 1 - for pure palladium, 2 - for the α-PDH0.0077 alloy, 3 - for the α-PDH0.0177 alloy

CONCLUSIONS:

1. It has been experimentally shown that after reaching the maximum bending, a plateau is observed, which indicates the stabilization of the hydrogen penetration process, namely the establishment of a thermo-baroelastic diffusion equilibrium in palladium, which signals an equilibrium state between hydrogen penetration and the mechanical response of the α-PdHn alloy.
2. The study showed that the duration of the relaxation process of hydrogen concentration stresses after each injection increases with increasing hydrogen content.
3. The experimental results show that for the α-PdHn alloy, the maximum bending of the cantilever decreases with the same increase in hydrogen concentration with each subsequent injection of hydrogen into the chamber.
4. This opens up new prospects for predicting the mechanical properties of materials used in environments with a high hydrogen content.