INVESTIGATION OF HYDROGEN DIFFUSION THROUGH $Au_{40}Pd_{60}$ MEMBRANE

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It is well-known that Pd with Ag, Au and others metals alloys are capable to pass hydrogen through themselves acting as selective hydrogen membranes. Hydrogen reaches from gaseous or liquid phase to Pd-lattice (or alloys) for few stages: dissociation of hydrogen chemisorbed molecules on the Pd-surface (or alloy's surface), migration of chemisorbed hydrogen atoms along surface to the most favorable pass-place, where they can reach in the lattice and at last transition of hydrogen atoms from surface states in the lattice. The process of hydrogen moving off consist the same stages in reverse order [1].

The appearance of new microelectronic sensors of total pressure reduced to create enough simple equipment for determination of H_2 fugacity in situ in investigated wide-ranging of temperatures and total pressures systems on basis of H_2-membrane. The Au-Pd alloys are the most perspective ones from the point of view that they have a comparative chemical inertness in corrosive mediums, including hydrogen sulphide. Therefore the $Au_{0.4}Pd_{0.6}$ alloy was chosen as a membrane.

The measuring system (MS) consists of membrane thickness of 0,2 mm and diameter 8 mm in holder, pressure sensor PX72-030GV (the mistake consist 0,05 % of determination value), two one-way valves and one two-way valve, connecting capillaries and measuring bloc with computer registration of values. The construction permits completely check of measuring system efficiency, which have internal volume is about 0.5 sm^3 at most.

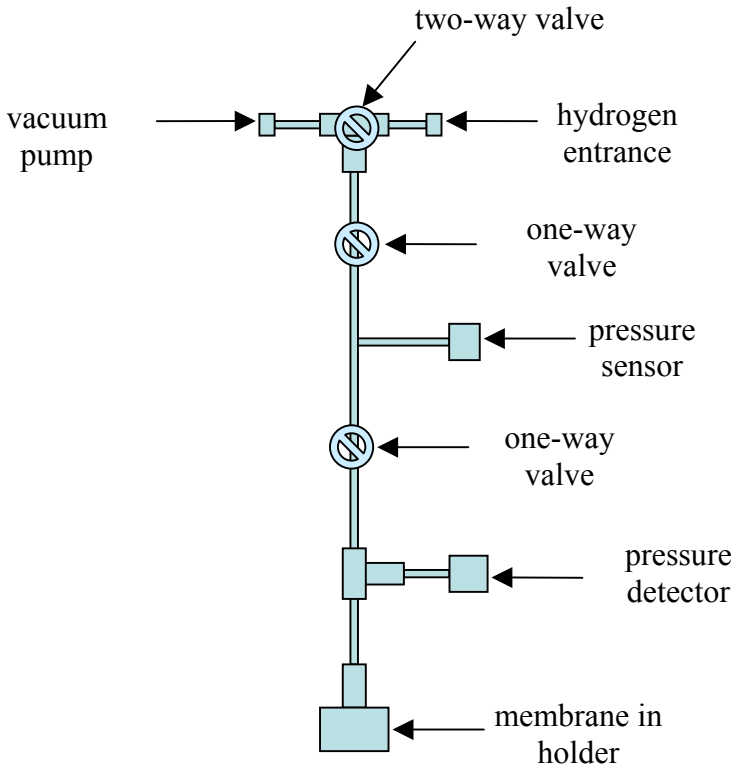
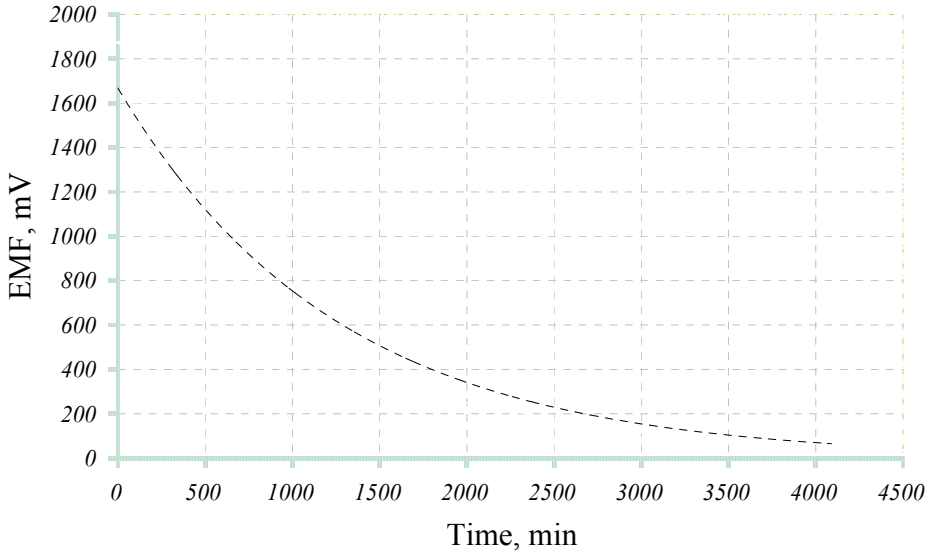


Fig. 1a. The measuring system's scheme

Before location to measuring system the membrane in the holder was tested for the strength in high-pressure vessel (1500 bar, water), at room temperature during two days. After that the MS was pumped out. Vacuum-processed to 10^{-4} bar MS was tested for the strength too. Vacuumization and

hydrogen filling (at the atmosphere pressure and room temperature) operations were repeated 3 or 4 times. As a result the MS was whole filled with only hydrogen. At room temperature the rapid of hydrogen pressure drop was enough insignificant (at rough estimate – decade in a month). At process of heating of membrane with it's holder to 358°K the hydrogen pressure was decreasing exponentially and reached the pressure of vacuum-processed MS in 12-15 hours (Fig. 1).



time, h	*p*(H2), bar	time, h	*p*(H2), bar
0	1	33	0,11
2	0,84	50	0,05
5	0,66	67	0,04
10	0,49	68	0,04
20	0,41	85	0,04
23	0,24		

Fig. 1b. The hydrogen modification at membrane diffusion

The resume of hydrogen diffusion through $Au_{0.4}Pd_{0.6}$ membrane investigation:

- MS is very sensible for small pressure fluctuations (the hydrogen filling and closed MS showed fluctuations of environment's temperature);
- Hydrogen diffusion through membrane is inessential therefore heating of membrane is necessary at low temperature (in our case it is room temperature);
- Hydrogen diffusion in Au0.4Pd0.6 alloy has exponential dependence at 358°K; therefore, system's equilibrium is reached rather quickly;
- Hydrogen diffusion's rapid exponentially increases with increase of temperature.

Reference

1. Hydrogen in Metals II. Ed. by Alefeld G., Volkl J. - Springer-Verlag, 1978.

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