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The Pressure Oscillations Phenomenon Observed During Natural Cooling of Pressure Chamber Filled By Dense H_2 and Metallic Pd Specimen after Complex - γ and $^-$e Irradiation Procedure

Roland Wiśniewski[1,2*], Wilczyńska T[2], Mishinsky G.V[3] and Alexander Yu. Didyk[3]

[1]*Warsaw University of Technology, Warsaw, Poland.*

[2]*Institute of Agricultural and Food Biotechnology, 36 Rakowiecka, 02-532 Warsaw, Poland.*

[3]*Joint Institute for Nuclear Research, Dubna, RF.*

[*]Correspondence:
Roland Wiśniewski, Warsaw University of Technology, Warsaw, Poland.

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ABSTRACT

In the paper, a new phenomenon of pressure oscillations in pressure chambers filled up by dense gaseous hydrogen and with pure Pd specimen of macroscopic dimensions, after irradiation by gamma quanta and electrons in specific doses - in a natural cooling state – is described.

Keywords

Metals, Pressure Oscillations Phenomenon, Irradiation.

Introduction

Behavior of different samples of metals such as Al, Bi, V, Cu, Pd, Sn, Re, YMn_2 alloy and stainless steel in the shape of rods or wires, placed in molecular deuterium gas under high pressure, irradiated on by braking γ-rays of 10MeV [1-7] and 23MeV [8-12] energy, have been studied. The element compositions of synthesized particles and objects, as well as the surface structure of inner elements of the deuterium high-pressure chamber (DHPC) were determined. Analogous investigations aimed to study the possibilities of nuclear reactions were performed using hydrogen high pressure chambers (HHPC) with Pd-rods inside [13] and in the presence of hydrogen without any metallic samples in the chamber [14,15] under irradiation by 10MeV braking γ-rays. The physical properties and possible crystallographic structure of the graphite-like objects which were found in the PC filled up before gamma irradiation only by pure gaseous helium under pressure (1-3) kbar are described in [16-19]. The aim of this paper is the presentation of so-called "Dubna oscillations phenomenon" of hydrogen pressure observed after irradiation of Pd-H system by braking γ-rays and by electrons (of E_{max} = 10MeV). This phenomenon was observed first time in the authors practice.

Experimental

Technical procedures and used by us high pressure apparatus has been widely described in all positions mentioned above. The goal of this paper is to present data not typical for our previously published experiments and results. Namely observed first time the not typical dependence on time of oscillating pressure value in HPC, during it natural cooling procedure, just after finish of not typical for us irradiation procedure. Some experimental data are following. For experiment, there was used dense hydrogen (initial pressure 1.2kbar, mean purity of 99.99 weight %) with palladium specimen of dimensions diameter of 3.8mm, length of 12,0mm and high purity of 22ppm. This time we have decided to use at the beginning the typical braking gamma irradiation procedure, at time T = E5s and after observation of its typical effects to apply electrons irradiation, by shorter time (T =4xE3s), noting higher temperature of pressure chamber (above 100°C). The observed pressure and temperature changes on time are presented in Figure 3. One can see oscillating character of pressure changes during almost whole - long time – observation process. The MT25 electron accelerator, Figure 2 [20], property of Joint Institute for Nuclear Research (Dubna, RF) was used with electron current 3-4 μA. Used in our experiment a portable high-pressure chamber (one of first construction) is shown on Figure 1. In further constructions a plastic o-ring sealing (5) were eliminated.

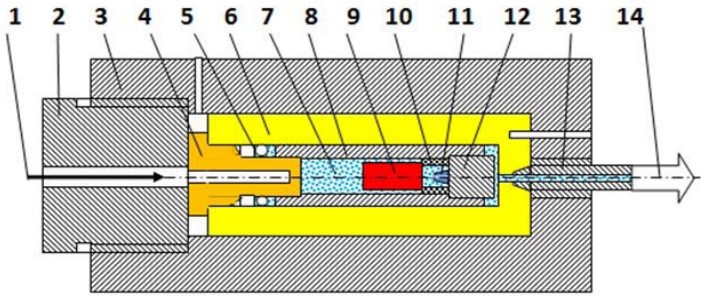

Figure 1: The schematic drawing of high-pressure apparatus (HPC). 1 – γ- quanta, electrons e-, other elementary particles flux, 2 – closing screw with hole, 3 – body reinforcing high pressure chamber, 4 - $Cu_{0.98}Be_{0.02}$ window- plug, 5 – high pressure seals, 6 – CuBe2 high pressure chamber, 7 – hydrogen (deuterium) under high pressure, 8 – brass sleeve, 9 – investigated Pd-rod, 10 – the distancing manganin sleeve, 11 – expected reaction product, 12 – brass screw, 13 – high pressure connecting capillary, 14 – high pressure valve, strain gauge pressure sensor and gas filling inlet. The arrow show the temperature measurement place.

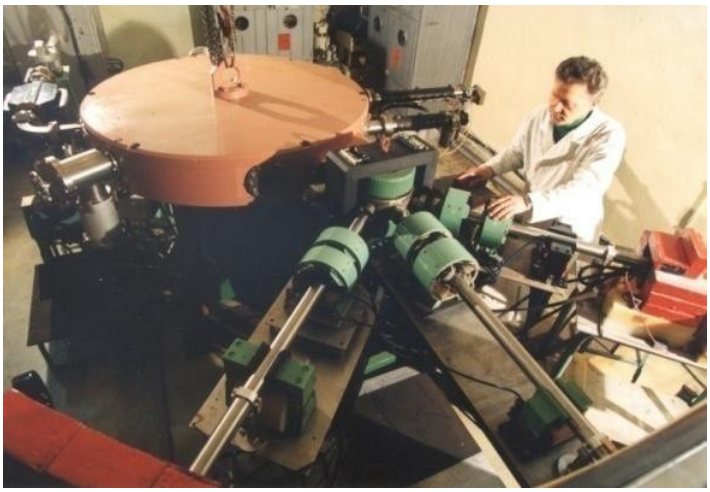

Figure 2: Electron accelerator MT23 in Dubna Center for Nuclear Investigations attainable for us in any time and for necessary exploitation time.

Main Results

Placing pressure apparatus far from the accelerator laboratory, also to be sure of the absence of other radiation effects, we have decided to observe the character of pressure and temperature dependencies at time in natural cooling the pressure chamber hoping to observe similar dependencies. Dependencies in reality proved to be different, namely – un-expected – in pressure dependences showing some kind of oscillations. Observed data, shown in Fig. 3 is for sure correct although is observed only one time. After approximately 1-hour time the HP valve was delicately opened and controlled pressure decreasing took place. Disappearance of oscillation phenomenon at the ending procedure was noted. The time of cycle is rather long about 20 min.

During observed three cycles, no change in the average pressure was noted, and the oscillation amplitude values were practically constant ~ about 120 bar against the background of the observed gradual decrease in temperature. The mechanism of the observed phenomena, in our opinion, is associated with the growing solubility of hydrogen in palladium microstructures during their local cooling. The pressure in the chamber decreases. Increasing the concentration of hydrogen in microstructures induces reactions of cold nuclear fusion and low-energy transmutation of atoms of chemical elements [21-24]. The energy released in these processes heats up the microstructures of palladium and hydrogen leaves them. The pressure in the chamber rises, and low-energy reactions stop. The release of energy in the reactions decreases and the palladium microstructures cool down again. The oscillations are repeated.

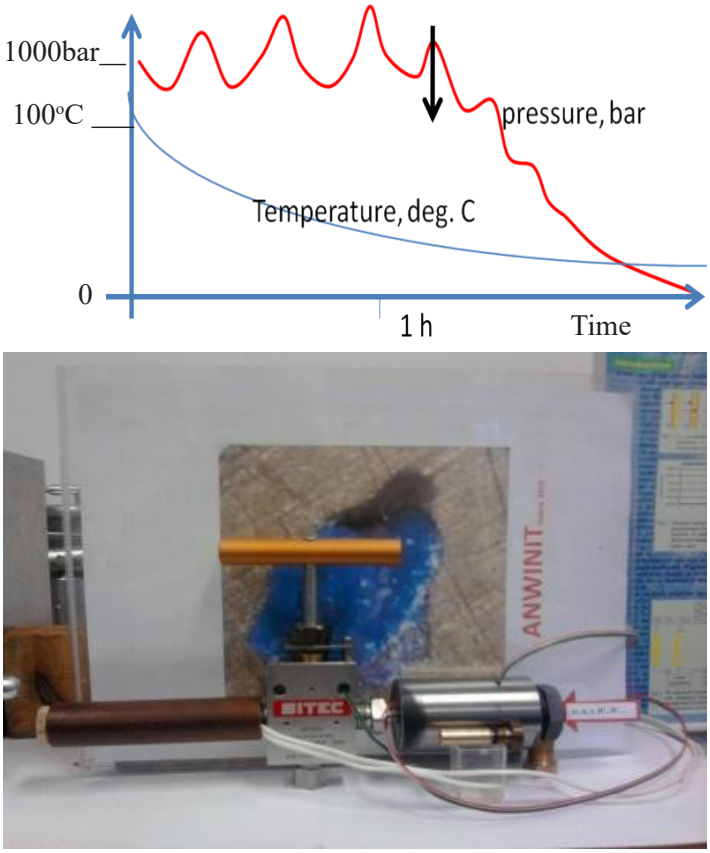

Figure 3: Oscillating character of hydrogen pressure dependence on time with monotonic, natural, temperature decreasing of pressure chamber (and in approximation of hydrogen and Pd specimen). Arrow shows start time of delicate valve opening. On the right, a view of the HP set.

Conclusion

This publication has particular meaning. Experiment is performed together with Professor A. Yu. Didyk († 13.04.2016) and is devoted to His Memory. Publication has preliminary character. In correct political conditions, we do hope in the not too far future, that experiment will be repeated and will then be given a possible interpretation. Preliminary we can supposing that some Low Energy Nuclear Reaction takes place. Is temperature decreasing important parameter for described here phenomenon, is the time of phenomenon short, long or very long, what about temperature changes inside the pressure chamber system in dense hydrogen gas and Pd specimen and so on are fundamental problem for

explanation. For sure, the added irradiation of –e related to the results of the "γ, H_2, Pd" experiment described in [7] had basic meaning. Note: the "macro" nature of oscillations (big period time) may be the basis for the claim of the existence of new nuclear-crystalline interactions. The production of new elements in the palladium sample and on the surfaces of internal structural elements is more advanced than in the case of irradiation only with gamma quanta [7]. This topic will also be dealt with separately later.

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