NEUTRINO–DINEUTRON REACTIONS (LOW-ENERGY NUCLEAR REACTIONS INDUCED BY D_2 GAS PERMEATION THROUGH PD COMPLEXES. Y. IWAMURA EFFECT)

V. MUROMTSEV AND V. PLATONOV

State Scientific Centre of Russian Federation Karpov Institute of Physical Chemistry, 10, Vorontsovo Pole Street, 103064 Moscow, Russia

I. SAVVATIMOVA

Federal State Unitarian Enterprise Scientific Research Institute "Luch", 142100, Podolsk, Zhelesnodorozhnaya Street, 24, Moscow region, Russia

Anomalous elemental changes have been observed on the Pd complexes after D_2 gas permeation. This effect—effect Y. Iwamura—belongs to a new category of nuclear reactions. The effect of Y. Iwamura can stimulate development of physics of electromagnetic interaction neutrino including physics of relic neutrino and physics of the dineutrons. It is possible to suggest that low-energy neutrino and even relic neutrino can initiate effect of transmutation in special cases. The suggested hypothesis application about new class ν^- nuclear reaction existence can be useful for the problems: alternative energetic, radioactive isotopes reducing and rare isotopes production.

1. Introduction

Recently some experimental evidences confirming the assumed existence of the relic neutrino and the anomalous neutrino magnetic moment have been obtained. The said assumption is based on the concept of occurrence of stable dineutrons; the function of neutrino and dineutrons in phenomena studied by physical chemistry and low-energy physics. The existence of bound states of neutrino (latent) with protons, deuterons, and other nuclei follows from the well-known estimations of anomalous neutrino magnetic moment[1] and the Dirac's equation.[2,3] The concept of relic neutrino leads to the possibility of the neutrino component of the matter. If we assume the existence of the neutrino component of the matter, the question arises as to whether these neutrinos are capable of initiating nuclear transmutations. Nuclear experimentation evidence shows that small quantities of nuclei occur in excited meta-stable nuclear states. Capture of neutrino by the said nuclei may trigger transition from the excited meta-stable states to the basic one and lead to the output of energy sufficient to initiate nuclear transmutations.

The above concept provides grounds to study the problems of neutrino and the dineutrons function in a number of processes, discovered in experiments in allied areas of physical chemistry and nuclear physics. One of the approaches to the study of neutrino physics may be focused on investigation of reactions of the following type.

$$\nu_{\mathrm{e}} + {}^{N}_{Z}\mathrm{X} \rightarrow {}^{N-2}_{Z}\mathrm{X} + {}^{2}\mathrm{n} + \mathrm{i}_{\mathrm{e}}, \tag{1}$$

where ^{2}n represents dineutrons.

$$\nu_{\mathrm{e}} + {}^{N}_{Z}\mathrm{X} \rightarrow {}^{N-6}_{Z-2}\mathrm{X} + {}^{4}_{2}\mathrm{He} + {}^{2}\mathrm{n} + \mathrm{i}_{\mathrm{e}}, \tag{2}$$

$$\nu_{\mathrm{e}} + {}^{N}_{Z}\mathrm{X} \rightarrow {}^{N-14}_{Z-6}\mathrm{X} + {}^{12}_{6}\mathrm{C} + {}^{2}\mathrm{n} + \mathrm{i}_{\mathrm{e}}, \tag{3}$$

$\mathrm{i}_e \equiv \mathrm{e}^{+}\ \nu_{\mathrm{e}}\ \mathrm{e}^{-}$ bound states of neutrino with the electron–positron pair (the particle called “iton” by Dr. T. Matsumoto).

Reaction (1) may be termed as neutrino–dineutron reaction.[4,5] Reactions (2) and (3) may be regarded as initiated neutrino-cluster reactions of helium and carbon decay.[6]

The assumption on the occurrence of reactions (1)–(3) appeared as a result of the study of the background gamma spectra formation in germanium gamma spectrometers, used in astrophysical research.[4] Given below is experimental evidence on the existence of reactions (1)–(3). The data proving the existence of the above reactions are also provided

$${}^{N}_{Z}\mathrm{X} + {}^{2}\mathrm{n} \rightarrow {}^{N+2}_{Z}\mathrm{X} + \gamma, \tag{4}$$

$${}^{N}_{Z}\mathrm{X} + {}^{12}_{6}\mathrm{C} \rightarrow {}^{N+12}_{Z+6}\mathrm{X} + \gamma, \tag{5}$$

$${}^{N}_{Z}\mathrm{X} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{N+4}_{Z+2}\mathrm{X} + \gamma. \tag{6}$$

The study of the assumed existence of reactions (1)–(6) may be regarded as one of the goals of the present investigation. It is suggested that these reactions are accounted for by the electromagnetic low-energy neutrino interaction.

According to the assumed hypothesis a number of protons $\mathrm{p}^{+}$and deuterons D^{+}occur in plasma in bound states (latent) of protons and deuterons with neutrino ($\mathrm{p}^{+}\nu_{\mathrm{e}}$ and $\mathrm{D}^{+}\nu_{\mathrm{e}}$, respectively). As a result of a collision, for example, of deuteron with neutrino in a latent state with the Pd cathode surface, part of the neutrino may be captured by Pd isotopes.

$$\mathrm{D}^{+}\nu_{\mathrm{e}} + \mathrm{Pd} \rightarrow \mathrm{D}^{+} + \mathrm{Pd}\nu_{\mathrm{e}}. \tag{7}$$

The bound state of some isotopes with neutrino decays in some cases in accordance with reactions (1)–(3).

2. Experiments with Glow Discharge (GD)

Proceeding from the assumed occurrence of reaction (3), isotopes with masses 90 and 91 are formed in the reactions.[7,8]

$$\nu_e + {}^{104}_{46}\mathrm{Pd} \rightarrow {}^{90}_{40}\mathrm{Zr} + {}^{12}_{6}\mathrm{C} + {}^{2}\mathrm{n} + \mathrm{i}_e, \tag{8}$$

$$\nu_e + {}^{105}_{46}\mathrm{Pd} \rightarrow {}^{91}_{40}\mathrm{Zr} + {}^{12}_{6}\mathrm{C} + {}^{2}\mathrm{n} + \mathrm{i}_e. \tag{9}$$

Among stable Pd isotopes, only ^{105}Pd has other than zero magnetic moment. ^{107}Pd isotopes were discovered in the Pd cathode. This effect can be accounted for by the dineutron capture by ^{105}Pd (4).

$${}^{2}\mathrm{n} + {}^{105}\mathrm{Pd} \rightarrow {}^{107*}\mathrm{Pd} + \gamma. \tag{10}$$

Figure 1 in Ref. 7 shows activity decrease curves in silver foils after the exposure in the vicinity of the Pu–Be neutron $10^5\,\mathrm{C}^{-1}$-active source and after the exposure of Pd to D in the GD chamber (at the same distance). Both curves correlate with the silver 110 half decay period. The effect of the neutrons flow upon the silver foil may lead to ^{110}Ag isotope formation.

$$\mathrm{n} + {}^{109}\mathrm{Ag} \rightarrow {}^{110m}\mathrm{Ag} + \gamma. \tag{11}$$

Beta-minus ^{110}Ag isotopes decay leads to formation of beta-electrons with 2.87 MeV energy. The ^{110}Ag isotopes half decay period amounts to 24.6 s. The curves of the emission intensity sharply decline in the silver foil after the exposure to those of the GD exposure. Assumedly, GD emits a dineutrons flow and the exchange reaction takes place:

$${}^{2}\mathrm{n} + {}^{107}\mathrm{Ag} \rightarrow {}^{107m}\mathrm{Pd} + \mathrm{d}. \tag{12}$$

It results in formation of ^{107m}Pd isotopes meta-stable states. The half decay period of ^{107m}Pd isotopes meta-stable states is equal to 21.3 s. Therefore, it is essential to determine the type of the silver foil emission: electrons flow or gamma-emissions with 215 keV. Gamma quanta may be generated (occur) as a result of ^{107}Pd isotopes transfer from the meta-stable state to the basic state. Stable dineutrons were initially discovered in investigations of Japanese physicists.[9]

3. Nuclear Transmutations in Electrolysis[10]

It was discovered that post-experimental Ni content in 2000 Å -thick thin-film nickel coatings decreases markedly as a result of electro-chemical process and new elements appear in significant quantities among which there are Fe, Cu, Zn, and Mg. Specifically high carbon content is registered. The experiments provide evidence that low-energy interactions in electro-chemical cells initiate nuclear transmutations. The said phenomenon was reproduced in Ref. 11 (Table 1). It was discovered that there appeared about 24% of carbon isotopes in the Pd cathode near-surface layer as a result of the electro-chemical process. Presumably, reactions of carbon cluster decay (3), initiated by neutrino's capture occur in these processes.

Element	Atomic concentration (%)
C	23.68
Pd	76.32

4. Effect of Y. Iwamura (Nuclear Transmutation Induced by Deuterium Permeation through the Pd Complexes)

In Refs. 12–14 processes in multi-layer Pd were investigated. The Pd complex consisted of bulk Pd at the bottom, alternating CaO and Pd layers, and a Pd thin film at the top Fig. 5 in Ref. 12 outlines this process. In Ref. 12 it was discovered that some carbon isotopes are found on the surface of the Pd complex. The diffusion of deuterium through the Pd complex leads to the decrease of the carbon content on its surface. At the same time Mg isotopes appear (Fig. 2 in Ref. 13).

The data obtained allows us to suggest that the following reactions take place.

$$ {}^{12}_{6}\mathrm{C} \; + {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{24}_{12}\mathrm{Mg} \quad + \;\gamma. \tag{13}$$

Presumably, the diffusion of D through the membrane should be regarded as neutrino transport (in neutrino-deuteron bound state) and initiation of neutrino-transfer reaction (7). As a result of neutrino capture, reactions (3) may be triggered, which lead to ^{12} isotopes formation.

In one of the experiments, ^{7}Li isotopes had been implanted into the surface of the Pd complex. ^{19}F isotopes were discovered in the surface layer after D diffusion through the Pd complex. It is possible that the following reaction type was observed in Ref. 12.

$$ {}^{7}_{3}\mathrm{Li} \; + {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{19}_{9}\mathrm{F} \quad + \;\gamma. \tag{14}$$

Natural Ba was deposited on some samples using the electrochemical method, in a 10 mM $Ba(OH)_2$ solution. On other samples, a special form of Ba with enriched ^{137}Ba was deposited, in 7.3 mM $Ba(NO_3)_2$ solution.

Figure 1a shows natural Ba mass spectrum. Mass peaks of 134, 135, 136, 137, and 138 are observed on the spectrum. Sm isotopes are discovered in the Pd complex with implanted Ba. Figure 1b represents this effect. The quantity of formed ^{150}Sm isotopes is less than that of ^{148}Sm or ^{146}Sm isotopes. In D diffusion through the Pd complex the quantity of ^{150}Sm isotopes increases dramatically. The rate of odd Sm isotopes formation is relatively small. No odd mass peaks are observed within the spectrum (Fig. 1). Figure 1 shows two mass spectra within 146–150 mass range. One of the spectra was obtained as a result of Ba isotopes implantation into the Pd complex. Ba and Sm isotopes were registered in the Pd complex after the electro-chemical experiment.

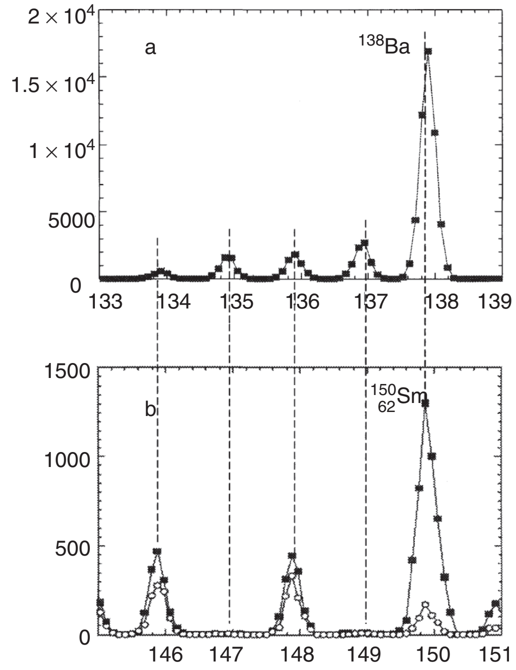

Fig. 1. (a) The secondary ion mass spectrometry (SIMS) spectrum of natural Ba. (b) SIMS spectrum of Pd complex with natural Ba after D_2 permeation.

The second mass spectrum was obtained after D diffusion through the Pd complex, containing Ba and Sm. A dramatic change in the intensity of the mass peaks was observed after D diffusion. The data in Fig. 1 was obtained with natural abundance barium isotopes. After barium had been implanted into the Pd complex 146, 148, and 150 mass peaks appeared in the mass spectrum. This may be explained by the assumption that the electrochemical process of Ba implantation triggers reaction (3) and fusion reaction (5) and the following reactions take place

$$ {}^{134}_{56}\mathrm{Ba} \;+\; {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{146}_{62}\mathrm{Sm} \;+\; \gamma, \tag{15} $$

$$ {}^{136}_{56}\mathrm{Ba} \;+\; {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{148}_{62}\mathrm{Sm} \;+\; \gamma, \tag{16} $$

$$ {}^{138}_{56}\mathrm{Ba} \;+\; {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{150}_{62}\mathrm{Sm} \;+\; \gamma. \tag{17} $$

No 147 and 149 mass peaks are observed on the spectrum in Fig. 1. This suggests that the cross-section of ^{12}C capture by odd ^{137}Ba isotopes is less than by even Ba isotopes (Ba mass spectrum, enriched with ^{137}Ba). ^{137}Ba content is about 60 times bigger than that of ^{138}Ba. As a result of D diffusion through the Pd complex (enriched with ^{137}Ba) 149 mass peak shows the maximal intensity. It suggests that the nuclear reaction of the below type is going on:

$$ {}^{137}_{56}\mathrm{Ba} \;+\; {}^{12}_{6}\mathrm{C} \;\rightarrow\; {}^{149}_{62}\mathrm{Sm} \;+\; \gamma. \tag{18} $$

Nuclear reactions in diffusion processes are observed only in Pd complexes containing an intermediary layer with Ca isotopes.[12–14] The neutrino capture cross-section in reactions (3) with Ca isotopes is much bigger than in reactions of this type with Pd isotopes. In reactions (3) with Ca isotopes appear Si isotopes:

$$\nu_{\mathrm{e}} + {}^{42}_{20}\mathrm{Ca} \rightarrow {}^{28}_{14}\mathrm{Si} + {}^{12}_{6}\mathrm{C} + {}^{2}\mathrm{n} + \mathrm{i}_{\mathrm{e}} \tag{19}$$

5. Conclusion

The most controversial are the following problems: the existence of the neutrino component of the matter, the ability of low-energy neutrino to initiate nuclear transmutations, and the existence of stable dineutrons. Many researchers made attempts to find stable dineutrons, but they failed.[15] The experiments aimed at discovery of stable dineutrons were based on outdated estimation of bound energy between two neutrons in a dineutron. According to these estimations the bound energy between two neutrons in a dineutron was assumed equal to about 3 MeV.[15] New evidence shows that the bound energy between two neutrons in a dineutron amounts to about 22 MeV. The system of quanta states in a dineutron was studied in Ref. 16. The first and the second quantum states with energies of 3.6 and 11.6 MeV, respectively, were discovered.

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