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Nuclear Transmutations in Polyethylene (XLPE) Films and Water Tree Generation in Them (2)*

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Abstract

An explanation of the nuclear transmutation (NT) observed in the XLPE (crosslinked polyethylene) films dipped in aqueous electrolytic solutions with and without application of high-frequency electric field has been given by the neutron-drop model, an extended version of the TNCF model, used in the theoretical investigation of the cold fusion phenomenon (CFP) in transition-metal hydrides/deuterides (CF materials). Thus, we have concluded that the generation of water trees in XLPE samples is caused by nuclear reactions induced by the CFP at around spherulites, a mechanism of which may be explained by the neutron-drop model proposed by us already. Furthermore, the new observation of the γ-ray emitted from ^{214}Pb and ^{214}Bi is explained by the TNCF model. The NT found in XLPE may have a direct relation with the NT's found in biological systems (biotransmutations) as discussed in another paper presented at this Conference.

1. Introduction

We have analyzed the emergence of new elements in XLPE where were water trees after application of high-voltage RF fields [Kumazawa 2005, 2006, 2007, Kozima 2008]. The NT's, K → Ca, Mg → Al, $^{56}_{26}$Fe → $^{57}_{26}$Fe and Fe → Ni, have been explained successfully by a single neutron absorption with or without a succeeding

beta-decay to get final nuclides. The NT's, $^{56}_{26}Fe \rightarrow {}^{64}_{30}Zn$ and $^{56}_{26}Fe \rightarrow {}^{60}_{28}Ni$, have been explained by absorption of a neutron drop $^{8}_{4}\Delta$ and $^{4}_{2}\Delta$, respectively, in the CF-matter that was supposed to be formed at boundary regions of crystallites in the sample [Kozima 2006]. Production of wonderful elements Li, Pb and Bi is discussed from our point of view.

In this paper, the new observation of the γ-ray emitted from ^{214}Pb and ^{214}Bi [Kumazawa 2007, 2012] is explained by the TNCF model.

2. Experimental Data

"*The applied HV to the samples was 2.7 kV_{rms} (average electric field = 1.1 kV/mm) and 2 kHz for about 1000 h*." [Taniguchi 2008]. They could not detect any neutron signals by the BF_3 detector. "*The source of the observed γ-ray was determined as ^{214}Pb and ^{214}Bi.*" [Taniguchi 2008].

"*We have observed and reported that weak γ-ray was radiated from water treed samples. ln order to study the influence of inorganic impurities such as metal ions in XLPE on the radioactivity, we measured X/γ-ray and neutron carefully from XLPE samples immersed in NaCl and/or $Pb(CH_3COO)_2$ solution using BF_3, CdTe and NaI detector in the condition of low background radiation. The counting rate of CdTe detector increased linearly with that of NaI detector, but each counting rate was not proportional to the growth of water trees. Furthermore、definitive residual radiation in the water treed samples, which attenuated rapidly to background level within a few hours after beginning of measurement, was observed by a Ge detector. We consider that the γ-ray observed during and after HV applying was emitted from ^{214}Pb and ^{214}Bi, as a result of analysis of the energy spectra. It is, however, difficult to explain that atmospheric radon gas (^{222}Rn) which decays to above isotopes accumulated abundantly in water treed samples, because HV was applied in an air-tight flask filled with the solution. On the whole, these phenomena on the radiation of X/γ-ray do not seem to be directly associated with the growth of water trees*" [Kumazawa 2012].

3. Theoretical Investigation

We have assumed existence of the trapped neutrons with a density n_n and a thermal energy in materials where occur nuclear reactions (CF materials) [Kozima 2014a]. Furthermore, we assumed that the neutron reacts with foreign nuclei in a CF material according to the same mechanism of the nuclear reactions in free space. Therefore, we can write down equations for reactions between a nucleus $^{A}_{Z}X$ (e.g. $^{A}_{82}Pb$) and a neutron *n* as follows (written explicitly only for *A* = 204 and 208);

$$n + {}^{204}_{82}\mathrm{Pb} \rightarrow {}^{205}_{82}\mathrm{Pb}^{*} \rightarrow {}^{205}_{81}\mathrm{Tl} - e^{-}, \quad (\tau = 1.53\times10^{7}\ \mathrm{y}) \tag{3.1}$$

$$n + {}^{208}_{82}\mathrm{Pb} \rightarrow {}^{209}_{82}\mathrm{Pb}^{*} \rightarrow {}^{209}_{83}\mathrm{Bi} + e^{-} + \underline{\nu}_{e}, \quad (\tau = 3.253\ \mathrm{h}) \tag{3.2}$$

where absorption cross sections are given as σ_{nPbA} = 0.661, 0.031, 0.712 and 0.421 b for A = 204, 206, 207 and 208, respectively. The decay time constant τ is given for reactions in free space in Eq. (3.1) or Eq. (3.2).

The nuclear transmutations observed in CF materials have been classified into several classes as explained in the next section. To explain some cases of the nuclear transmutation where new nuclei with large changes of nucleon numbers appear from that of nucleus existed in an original material, we can use the nucleon cluster ${}^{A}_{Z}\delta$ made of Z protons and (A – Z) neutrons instead of a single neutron n [Kozima 2004, 2006]:

$${}^{A}_{Z}\delta + {}^{A'}_{Z'}\mathrm{X} = {}^{A+A'}_{Z+Z'}\mathrm{X}, \tag{3.3}$$

$${}^{A}_{Z}\delta \rightarrow {}^{A}_{Z}\mathrm{X}. \tag{3.4}$$

The reaction (3.4) expresses a case where the nucleon cluster ${}^{A}_{Z}\delta$ transforms automatically into a nucleus ${}^{A}_{Z}\mathrm{X}$ in the cf-material.

The experimental data of the gamma emission from nuclei ^{214}Pb and ^{214}Bi observed by Kumazawa et al. [Taniguchi 2008, Kumazawa 2012] is explained by the following nuclear reactions in the TNCF model:

$${}^{6}_{0}\delta + {}^{208}_{82}\mathrm{Pb} = {}^{214}_{82}\mathrm{Pb}^{*} \rightarrow {}^{214}_{83}\mathrm{Bi}^{*} + e^{-} + \underline{\nu}_{e}, \quad (\tau = 26.8\ \mathrm{m}) \tag{3.5}$$

$${}^{214}_{83}\mathrm{Bi}^{*} \rightarrow {}^{214}_{84}\mathrm{Po} + e^{-} + \underline{\nu}_{e}, \quad (\tau = 19.9\ \mathrm{m}) \tag{3.6}$$

The nucleon cluster ${}^{6}_{0}\delta$ reminds us the polyneutron introduced by J.C. Fisher to explain the cold nuclear reactions in 1992 [Fisher 1992, 2005]. It is impressive to notice that the TNCF model developed to include the cf-matter in 2004 [Kozima 2004, 2006] meets with the idea of the polyneutron developed by J.C. Fisher in 1992 [Fisher 1992]. It should be noticed, however, that the Fisher's polyneutron exists in a nucleus while the neutron drops in the extended TNCF model are in the neutron bands ubiquitous over the CF material moving freely around the lattice nuclei and also alien nuclei.

These results obtained in XLPE are clearly demonstrating similar nuclear reactions of ${}^{A}_{38}\mathrm{Sr}$, ${}^{133}_{55}\mathrm{Cs}$ and ${}^{A}_{56}\mathrm{Ba}$ observed by Iwamura et al. [Iwamura 2006] catalyzed by a possible nucleon clusters ${}^{4}_{4}\delta$ to ${}^{16}_{4}\delta$ in our model [Kozima 2006, 2011];

$${}^{A'}_{4}\delta + {}^{A}_{38}\mathrm{Sr} = {}^{A+A'}_{42}\mathrm{Mo},$$

(A = 84, 86 – 88; A+A' = 92, 94 – 98, 100; A' = 4 – 16) (3.7)

In the cases of Cs and Ba, the relevant reactions are written down as follow;

$${}^{8}_{4}\delta + {}^{133}_{55}\mathrm{Cs} = {}^{141}_{59}\mathrm{Pr}, \tag{3.8}$$

$${}^{A'}_{6}\delta + {}^{A}_{56}\mathrm{Ba} = {}^{A+A'}_{62}\mathrm{Sm}.$$

(A = 132, 134 –138, A+ A' = 144, 147 – 150, 152, 154; A' = 6 – 22) (3.9)

In the case of the third reaction (3.9) [Iwamura 2006], the transmutation from $^{137}_{56}$Ba and $^{138}_{56}$Ba to $^{149}_{62}$Sm and $^{150}_{62}$Sm, respectively, are explained by the reaction associated with the nucleon cluster $^{12}_{6}\delta$ (A' = 12). However, there remains possible participation of other nucleon clusters as noticed in the bracket of Eq. (3.9).

The data of Pr from Cs and abundance of $^{96}_{42}$Mo correlated to the amount of $^{A}_{38}$Sr suggest us the stability of $^{8}_{4}\delta$ in the CF-matter formed in their CF materials (Pd complexes) at their boundary/surface region. The multi-neutron transfer is a problem discussed in the nuclear physics as we have discussed it in our paper presented at JCF14 [Kozima 2014b]. This fact gives us a strong support to use the idea of the nucleon cluster $^{A}_{Z}\delta$ in the explanation of nuclear transmutations in the CFP.

4. Conclusion

The complex experimental data sets in the CFP occurring in such CF materials as transition metal hydrides (NiH_x, PdD_x, - - -) and carbon-hydrogen systems (graphite hydrides, XLPE and biological systems) have been successfully explained from a unified point of view on our phenomenological model (TNCF model) [Kozima 1998, 2006, 2015(8)].

The experimental data on the emission of gamma rays from nuclei ^{214}Pb and ^{214}Bi observed by Kumazawa et al. [Taniguchi 2008, Kumazawa 2012] have been explained by assumptions of absorption of a neutron drop $^{6}_{0}\delta$ by $^{208}_{82}$Pb (Eq. (3.5)) and succeeding decays of the resultant nuclides $^{214}_{82}$Pb* and $^{214}_{83}$Bi* in the frame of our model.

Thus, we have another evidence of successful applications of our phenomenological model to the CFP. We may be able to conclude that the science of the CFP is a science of neutrons in CF materials not developed until now as discussed in our papers presented recently by us [Kozima 2014c, 2016].

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