# CALCULATION OF PRIMARY PRODUCTS OF RADIATION-CHEMICAL YIELD FORMING INSIDE BeO UNDER GAMMA QUANTA

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Beryllium and its compounds are widely used in various fields of nuclear energy. Under influence the of ionizing radiation ($\gamma$ −quantums, protons, neutrons, α-particles, etc.) within, on the surface and the surrounding environment of them to predict the changes that may occur is one of the main challenges in the science and technique. $\gamma$ −quantums passing through of substance are interacting with the atoms or molecules, the atomic nuclei and their electrons and the impact of this interaction on the energy has following types: Coherent scattering, fotoeffekt, Compton scattering (Compton-effect), the electron-positron pair formation and nuclear fotoeffekt. Monochromatic quantum by $E_\gamma = 1{,}13$ and $1{,}33\ MeV$ energy ($^{60}$Co) passing through the $BeO$ effective cross section of compton scattering very large compared to other processes and only compton scattering taken into account in the work.For this reason, the influence of $(10^{-15}\ san)$ $\gamma$ −quanta in the initial of the physical process for forming into $BeO$ stuffing electrons (Compton electrons) has been calculated the energy spectrum of electrons and in subsequent physico-chemical stage $10^{-15} \div 10^{-12}$ sec. has been determined of radiation-chemical yields of electron-hole pairs forming in interaction of electrons and medim and electronic-excitation cases. It has used the Stabler [1] proposed polyclassical formula for the effective cross-sections of ionization (electron-hole pair creation) and for various types of electronic-excitation in model. On the electron-electron interaction the effective cross-sections of electron-hole pair creation and electron-excitation calculated according to this formula:

$$\frac{d\sigma_1}{d\varepsilon} = N_0 \frac{\pi e^4 N}{\varepsilon^2 E}\left(1 + \frac{4\text{İ}}{3\varepsilon}\right) \qquad E_1 \le \varepsilon \le E - \text{İ} \qquad (1)$$

$$\frac{d\sigma_2}{d\varepsilon} = N_0 \frac{\pi e^4 N}{\varepsilon^2 E\sqrt{\text{İ}}}\left[\sqrt{E-\varepsilon} + \frac{4\sqrt[3]{(E-\varepsilon)^2}}{3\varepsilon}\right] \qquad E - \text{İ} \le \varepsilon \le E \qquad (2)$$

where, $E$ −kinetic energy of the electron, $E_1$ −the first excitation cases of atom or molecule, $N$ −the number of electrons in unit volume (concentration), $I$ −ionization potential, $e$ −the electron's electric charge, $\varepsilon$ − electron energy loss, and $N_0$ − constant for the system and determine according to this formula:

$$N_0 = \frac{E}{A\left(B - \frac{1}{E-I}\right)}, \qquad A = \pi e^4 N, \qquad B = \frac{1}{E_1} + \frac{2I}{3E_1^2}$$

The calculation has been determined by used Monte-Carlo single collisions and stride methods, on the basis of MATHCAD program. By the of successive collisions method [1, 2, 3] has been followed the amount of energy supplied to the system of the Compton electrons to electronic speed up first $N_s = 1 \div 10^5$. This process occurs at high speed , and ends within $10^{-15} \div 10^{-12}$ seconds. To find an effective cross section of the transition $n$ −pozition to need to integrate the expressions of the transverse peak of (1) and (2) formules.

$$\sigma_{0n} = \int_{\text{İ}_i}^{\text{İ}_{i+1}} \frac{d\sigma}{d\varepsilon} d\varepsilon \qquad (3)$$

For to find an effective cross section of ionization that need to integrate the entire spectrum of the expression of the(1) and (2) formules:

$$\sigma_i = \int_{\text{i}}^{E} \frac{d\sigma}{d\varepsilon} d\varepsilon \qquad (4)$$

Calculation for radiation-chemical yield that forming inside ***BeO*** under the influence of gamma quanta of the excitation of electron (3) and electron-hole pair (4) in physical and physico-chemical stages of the process given in the table.

***Table***. *The radiation-chemical yield forming inside* ***BeO*** *under the influence of ($^{60}Co$) -quanta of the excitation of electron and electron-hole pair*

| No | electronic excitation of energy, eV | Excitation of the electron-yield | Yield of electron-hole pair |
|---|---|---|---|
| 1 | 10.2 | 0.20 | 1.41 |
| **2** | **10,5** | **0,58** | |
| **3** | **11,5** | **0.26** | |
| **4** | **12,0** | **0.34** | |
| **5** | **12,8** | **0,45** | |
| **6** | **15,1** | **1,10** | |
| 7 | collective excitation | **1,00** | |

Electron excitation -12;0 12,8; 15,1 eV and collective excitation states ($BeO^*$) turn to pair of electron ($e^-$) and ion ($BeO^+$) by dissociating ($BeO^* \rightarrow BeO^+ + e^-$). Taking into account the above-mentioned, inside BeO radiation-chemical yields of electron-ion pair and electron-excitation states have got the values of $4{,}1 \pm 0{,}2$ ion pair/(100 eV) and $1{,}06 \pm 0{,}2$ excitation state/(100 eV), respectively.

By this program within the scope of application of ionizing radiation arising from the influence of current density, the surface absorbed dose to the absorption of the power, transmitted to the environment $BeO$ –that surrounds it is possible, to calculate the amount of energy and the absorbed energy type. Calculations can be applied.

References

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