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AN APPLIED STUDY OF THE EFFECT OF SCATTERING OF THERMAL NEUTRON THROUGH A SAMPLE CONATION'S ARSENIC ELEMENT

Annotation: *The United States' Agency for Toxic Substances and Disease Registry ranked arsenic as number 1 in its 2001 Priority List of Hazardous Substances at Super fund site. In this paper, we conducted an applied study of an equation we had previously concluded [5], to investigate the possibility of neglecting the effect of neutron non-scattering, on the flux of neutron beams transient through a sample conation's Arsenic element, showing that, the probability of non- scattering of neutron beam flux can't be neglected for thermal energies. This study was used to determine more accurately to be used in determining the concentration of arsenic to reduce its toxicity.*

Key words: *thermal neutron, scattering neutron, Arsenic.*

ПРИКЛАДНОЕ ИССЛЕДОВАНИЕ ЭФФЕКТА РАССЕЯНИЯ ТЕПЛОВОГО НЕЙТРОНА ЧЕРЕЗ ОБРАЗЕЦ КОНАЦИОННОГО МЫШЬЯКОВОГО ЭЛЕМЕНТА

Аннотация: *Агентство Соединенных Штатов по регистрации токсичных веществ и болезней поставило мышьяк на первое место в своем приоритетном списке опасных веществ на сайте суперфонда за 2001 год. В настоящей работе мы провели прикладное исследование уравнения, которое мы ранее заключили [5], чтобы исследовать возможность пренебрежения влиянием нерасширения нейтронов на поток нейтронных Пучков, проходящих через Мышьяковый элемент образца конации, показывая, что вероятность нерасширения потока нейтронных Пучков не может быть пренебрежена для тепловых энергий. Это исследование было использовано для более точного определения, которое будет использоваться при определении концентрации мышьяка для снижения его токсичности.*

Ключевые слова: *тепловые нейтроны, рассеивающие нейтроны, мышьяк.*

1. Introduction:

Arsenic is a chemical element with symbol As and atomic number 33. Arsenic occurs in many minerals, usually in combination with sulfur and metals, but also as a pure elemental crystal. Arsenic is a metalloid. It has various allotropes, but only the gray form is important to industry. The primary use of metallic arsenic is in alloys of lead (for example, in car batteries and ammunition). Arsenic is a common n-type dopant in semiconductor electronic devices, and the optoelectronic compound gallium arsenide is the second most commonly used semiconductor after doped silicon. Arsenic and its compounds, especially the trioxide, are used in the production of pesticides, treated wood products, herbicides, and insecticides. These applications are declining, however [1]. A few species of bacteria are able to use arsenic compounds as respiratory metabolites. Trace quantities of arsenic are an essential dietary element in rats, hamsters, goats, chickens, and presumably many other species, including humans. However, arsenic poisoning occurs in multicellular life if quantities are larger than needed. Arsenic contamination of groundwater is a problem that affects millions of people across the world. The United States' Environmental Protection Agency states that all forms of arsenic are a serious risk to human health [2]. The United States' Agency for Toxic Substances and Disease Registry ranked arsenic as number 1 in its 2001 Priority List of Hazardous Substances at Superfund sites [3]. Arsenic is classified as a Group-A carcinogen [2].

The United States' Agency for Toxic Substances and Disease Registry ranked arsenic as number 1 in its 2001 Priority List of Hazardous Substances at Superfund sites [3].

The effect of the probability of non- scattering of neutron on flux of the neutron beam can’t be negligible for thermal energies. It is useful to determining more accurately the elements in any sample [5].

Because of the importance of the Arsenic element, we will apply the derived equation in [5] to a sample contains arsenic elements to determine the effect of probability neutron scattering on the flux of the transient neutron beam.

2. Method

The basic equation of the flux of a transient neutron beam directly through a sample, in which only the capture reaction is taken into account, is given [4]:

$$\Phi(x) = \Phi(0)e^{-n\sigma_c x} \qquad (1)$$

Where $e^{-n\sigma_c x}$ is the probability that there will be non-capture reaction when the neutron passed a distance x in the sample and exits directly (x is thickness of sample), and symbolizes it $P_{r\prime}(x)$, n is the concentration of nuclei in the sample, and σ_c is the microscopic capture cross section.

$$P_{r\prime}(x) = e^{-n\sigma_c x} \qquad (2)$$

In a previous study [4], we concluded that, the probability of non-decay of neutron when it was directly passed a distance x is:

$$P_{d'}(x) = e^{-\frac{\lambda}{v}x} \quad (3)$$

Where λ is the constant decay of free neutron, and v is the primary velocity of neutron.

Too [5], we concluded that, the probability of non- scattering of neutron when it was directly passed a distance x is:

$$P_{s'}(x) = e^{-n\sigma_s x} \quad (4)$$

Where σ_s is the microscopic scattering cross section. By taking the decay and scattering effect into account, the flux of the directly neutron beam through a sample of thickness x becomes:

$$\Phi(x) = \Phi(0)e^{-\left(\frac{\lambda}{v}+n\sigma_c+n\sigma_s\right)x} \quad (5)$$

3. Results and Discussion

Let's applied equations (2) , (3) and (4) for cylindrical sample of thickness x and radius r, made of natural mixture containing Arsenic, irradiated with a neutron beam from a source energy for thermal energy.

By calculate the effect of the propriety non-decay, the propriety non-capture, the propriety non-scattering of neutron on one of the sample isotopes, for example ${}_{33}As^{75}$, for different thicknesses of the sample and in the thermal energy, is:

Table 1: Probability $P_{r'}(x)$, $P_{s'}(x)$, and $P_{d'}(x)$, for different thicknesses of a sample at the thermal energy.

$x(m)$	$P_{r'}(x)$	$P_{s'}(x)$	$P_{d'}(x)$
0	1	1	1
0.01	0.823513	0.685964	0.21246
0.02	0.678173	0.470547	0.045139
0.03	0.558484	0.322778	0.00959
0.04	0.459919	0.221414	0.002038
0.05	0.378749	0.151882	0.000433
0.06	0.311905	0.104186	9.2E-05
0.07	0.256858	0.071468	1.95E-05

0.08	0.211526	0.049024	4.15E-06
0.09	0.174194	0.033629	8.82E-07
0.1	0.143451	0.023068	1.87E-07
0.11	0.118134	0.015824	3.98E-08
0.12	0.097285	0.010855	8.46E-09
0.13	0.080115	0.007446	1.8E-09
0.14	0.065976	0.005108	3.82E-10
0.15	0.054332	0.003504	8.11E-11
0.16	0.044743	0.002403	1.72E-11
0.17	0.036846	0.001649	3.66E-12
0.18	0.030344	0.001131	7.78E-13
0.19	0.024988	0.000776	1.65E-13
0.195	0.022676	0.000643	7.62E-14
0.2	0.020578	0.000532	3.51E-14

Figure (1) shows the proprieties of the three processes (non-capture, non-scattering, non-decay), and we notice that it decrease with increasing sample thickness; that is, the probability of transit decreases with thickness.

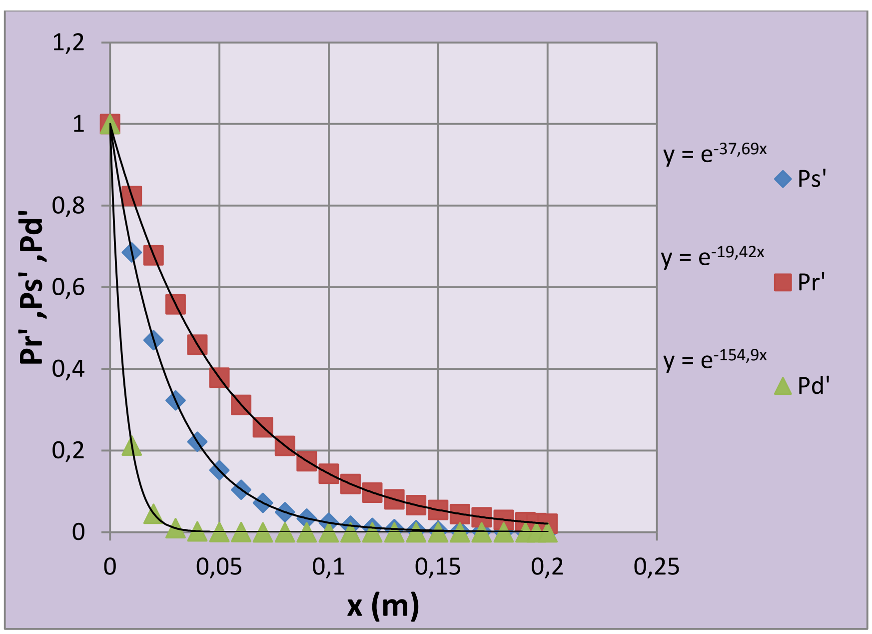

Figure (1): Probability $P_{r'}(x)$, $P_{s'}(x)$ and $P_{d'}(x)$ as a functions of sample thickness.

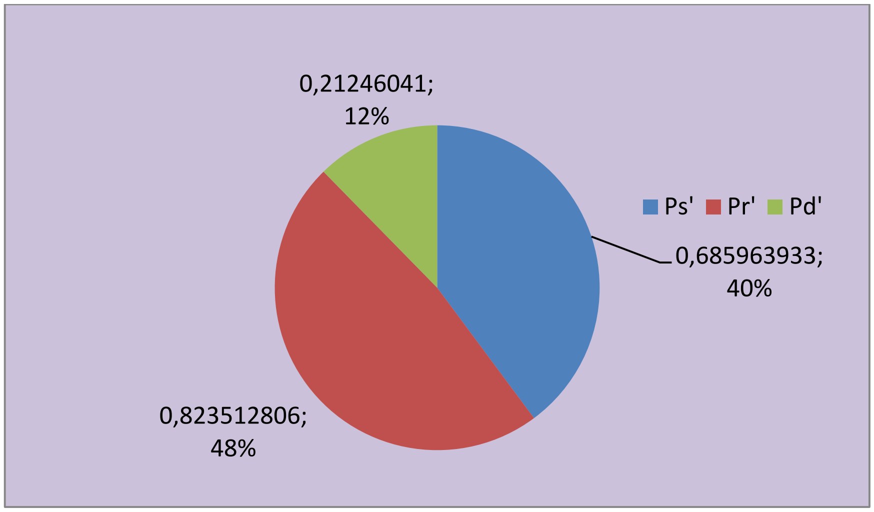

Figure (2): Probability $P_{r'}(x)$, $P_{s'}(x)$ and $P_{d'}(x)$ for the sample thickness $x = 0.01$ m.

Figure (2) shows the proprieties of the three processes (non-capture, non-scattering, non-decay) for a dental sample of thickness $x = 0.01$ m as an illustrative example of the effect of decay and scattering in neutron activation analysis, and its inadmissibility as usual. Where we notice from Figure (2) that $P_{r'}(x) > P_{s'}(x) > P_{d'}(x)$, indicating that the probability of non-capture is greater than the probability of non- scattering and non-decay, on the other hand, non- scattering and non- decay cannot be neglected for a sample of its thickness taken from Table (1).

4. Conclusions:

The effect of the probability of non-scattering and non-decay of neutron on the flux of the neutron beam can't be negligible for thermal energy. By taking this effect into account, determination the concentration of the Arsenic element can be more precisely determined to Ensure that its toxicity is reduced, especially When it using in the field of dentistry and pharmaceutical industries.

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