PROTON ACTIVATION ANALYSIS OF SOME CHEMICAL ELEMENTS ON A NUCLEAR REACTOR

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Accurate determination of lithium, oxygen and other light elements in sub microgram level is of importance in geochemical and material studies. Such examples are great many. On such instances, several non-traditional reactor activation analysis can be used which have increasingly been developed and applied to several fields of semiconductor industry, biology, geology in recent years [1]. These techniques can be named as the nuclear reactor based charged particle activation analysis.

We have been distinguished two possibilities of the application of a nuclear reactor as charged particles source for the development of the nuclear reactor based charged particle activation analysis (NRCPAA). At last years those possibilities were investigated intensively and some results of our study were applied for the determination of light elements [1-3].

We have considered the use of both thermal and fast neutron flux:

- The triton flow is produced by thermal neutrons flux, which excites the nuclear ^{6}Li (n, α) T reaction on lithium.
  The neutron activation analysis associated with below presented two consecutive ^{6}Li (n, α) T+^{16}O (T, n) ^{18}F reactions is established to determine trace amounts either of lithium or of oxygen in different samples. Besides, the triton flow can be used for the determination of other light elements, for instance, B, N, S, and Mg.
- The recoil protons are produced as the result of (n, p) elastic and inelastic scattering interaction of fast neutrons with nucleus of light elements, for example, hydrogen. These protons are applied for the development of proton activation analysis for the determination of large concentration of Li, B, N, O, Ti, S and other elements.

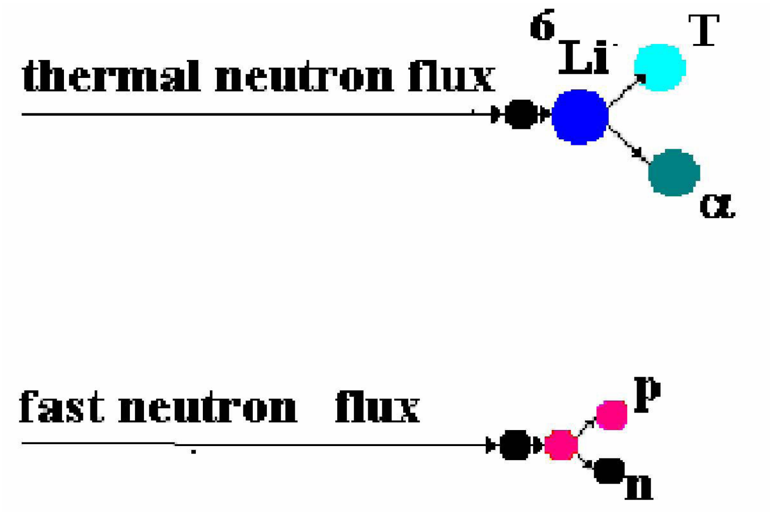

Fig. 1. Means of production of charged particles flow

The purpose of this presentation is the study of detection possibility of several chemical elements using the activation analysis based on the application of secondary nuclear reactions induced by recoil protons on a nuclear reactor.

We investigated the yields of radio-nuclides produced by secondary nuclear reactions with recoil protons on ^{18}O, S, Ti and V. Nuclear data for these radio-nuclides are listed in the Table 1.

The samples for investigation were prepared by dissolving metallic plates in tsar's vodka. Then the mixture was neutralized as an aqueous solution. In order to prepare the samples for irradiation, these solutions of 2 ml volume were dropped into filter-paper. At following step the samples are dried and put to the target-holder for irradiation. Distilled water was used as the sample for oxygen. For sulfur we used the method of mixing of powdered sulphur with liquid polyethylene. All samples are placed into the target-holder and irradiated in nuclear reactor.

Table 1. Nuclear data for investigated chemical elements

Chemical elements	Radio-nuclides	$T_{1/2}$	E_{γ}, keV; (I_{γ}, %);
O	^{18}F	1.83 h	511 (1993,4)
S	^{34m}Cl	31.99 m	3305 (11,6), 2928(48,4), 1174<4 (14,1), 640 (0,48) 511(120) , 145,7 (35,8)
Ti	^{48}V	16.18 d	2421.75-3), 2375,6 (0,010), 2240 (2,4), 1312 998), 983,3 ((100), 944,3 ((8), 511 (99,6)^
V	^{51}Cr	27.8 d	320 (9,63)

The activity was counted with the calibrated high-resolution γ-ray spectrometer connected to the 80 cm^3 Ge(Li) detector having an energy resolution of 3 keV FWHM at 1332 keV ^{60}Co. The efficiency of the detector was determined by using the standard sources. The detector was connected to a multi-channel analyzer placed in the 15 cm thick lead shield, covered with a plastic cup (the thickness of the wall is 5 mm), which served as the holder for a sample. Samples were put onto it. The gamma detection system allowed determining of Li, O-18 and other chemical elements.

In our experimental conditions Yields of ^{18}F, ^{48}V and ^{51}Cr were equal to 0,4 imp/s.ml, 1,1 imp/s.mg and 21,9 imp/s.mg, correspondently. For sulfur the radioactivity was not detected.The dependence of yields on contents of chemical elements is given in the Table 2.

Table 2. Yields of radio-nuclides produced on investigated chemical elements.

Ti			V		
Volume of solution, ml	Contents of chemical element, mg	Number of impulses, imp/s	Volume of solution, ml	Contents of chemical element, mg	Number of impulses, imp/s
0,25	0,46	0,54	0,75	0,497	10,8
0,5	0,92	0,65	1,50	0,994	7,9
1	1,84	0,70	3,00	1,989	13,2
2	3,69	1,00	6,00	3,978	9,1

Our experimental results have demonstrated that the proton activation analysis based on the application of secondary nuclear reactions is useful tool to determine large contents of some lpght and medium chemical elements.

REFERENCES

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