Estimation and Mode Selection of Deuterium Flux Supply into Ampoule Device through Diffusion Filter in Experiments with Pb-15.7Li Eutectic at the IVG1.M Reactor

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In first generation of fusion energy reactors hydrogen isotopes - deuterium and tritium will be used as a fuel. A reserve of tritium in nature does not exist, therefore, for tritium generation the design of fusion reactors involves a special device called breeder blanket, containing lithium. In lithium-containing materials under neutron irradiation the following reaction will occurs with breeding of tritium:

$$Li^6 + n = He^4 + T + 4{,}78\ MeV\ (\sigma_0 = 936 \pm 6 \cdot 10^{-24} cm^2)$$

Lead-lithium eutectic is considered as one of the most perspective material as a source of tritium for use in fusion reactor blankets [1]. Currently, lead-lithium eutectic selected as material of DEMO reactor blanket, intended to demonstrate the commercial attractiveness of fusion power engineering.

Tritium breeding should be the most effective and its leakage into environment should not exceed of maximum permissible values.

Therefore, there is an urgent neediness for study of tritium generation and release from lead-lithium eutectic directly under conditions of neutron irradiation.

For conduction of the present study a differential method was chosen. The method consists in following: during reactor experiment into ampoule device with eutectic sample a spectrally pure deuterium flux was supplied constantly through palladium-silver filter.

The paper presents the calculation results of diffusion, solubility, deuterium permeability coefficientsthrough the palladium-silver filter, activation energy of the processes and Arrhenius dependences. Based on the values obtained in calculations the modes of deuterium flux supply into ampoule device in experiments with Pb-15.7Li eutectic was determined.

Acknowledgments

The work was carried out within the framework of the grant financing support by the Ministry of Education and Science of the Republic of Kazakhstan with Grant No.AP05131677/GF5.

[1] I. Ricapito, P. Calderoni, Y. Poitevin, A. Aiello. Fusion Engineering and Design 89, 2014. P. 1469–1475