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TRITIUM AND HELIUM FORMATION IN A BERYLLIUM SLAB, LOCATED IN THE NEUTRON FLUX

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Abstract

Energy needs accelerate the development of methods for producing electricity , the most promising of which is , of course , nuclear power . In the nuclear power industry , such restrictions often associated with materials research , most of the problems which is either a justification for extending the life of the materials used in nuclear and thermonuclear devices or choice of materials or the creation of new materials with physical properties superior to the known use . Recently, increasing attention has been paid to such reactor materials like beryllium. Beryllium has a good set of neutron-physical characteristics : low neutron absorption cross section , high retarding capacity due to low atomic weight and high neutron scattering cross-section , so it is widely used in the nuclear industry as a material for reflectors , moderators , neutron sources , as well as the recent beryllium time began to attract interest in the use as a breeder , the first wall or limiter in fusion devices .

1. Accumulation of helium in beryllium under neutron irradiation

Irradiation of beryllium by fast particles contributes to the formation and accumulation of radiation defects in it, and the nuclei of helium and tritium from nuclear reactions in the beryllium atoms. Damage to the beryllium neutron irradiated is the result of two known in radiation physics processes - the elastic interaction of neutrons with nuclei and nuclear reactions ((n, 2n), (n, α)) []. In elastic interaction of neutrons with nuclei of atoms is shifted out of their seats. The total number of displacements during the irradiation is estimated by the formula

However, beryllium is subject to significant radiation damage under the influence of neutron radiation. Irradiation of beryllium by fast particles contributes to the formation and accumulation of radiation defects in it , and the nuclei of helium and tritium from nuclear reactions in the beryllium atoms . In certain irradiation parameters , these effects can cause significant changes in the physical and mechanical properties of the material , the main of which practical application is the density , thermal conductivity, strength and ductility. Possible duration of the work in this case is determined by the neutron fluence , at which the maximum permissible reduction in the quality of beryllium. Now the world is already a considerable amount of irradiated beryllium , which can not be used further without additional processing and clearing it from the radioactive products (major sources of beryllium are such a research nuclear reactors and some thermonuclear installations , for example , JET). After the commissioning of ITER and DEMO total number of irradiated beryllium significantly increase. Currently, irradiated beryllium goes to waste , but the high cost and the potential risk of making radio-ecological disposal of irradiated beryllium highly undesirable procedure:

$$n + Be^9 \rightarrow He^4 + He^6,\ E \geq 0,71 MeV \rightarrow {}^6Li + n_{th} \rightarrow {}^3H + {}^4He \qquad (0.1)$$