

INFLUENCE OF CHEMISORPTION PRODUCTS OF CARBON DIOXIDE ON RADIOLYSIS OF TRITIUM BREEDING CERAMIC

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Lithium orthosilicate pebbles (90mol% Li_4SiO_4 and 10mol% Li_2SiO_3) are internationally approved tritium breeding ceramic for fusion reactors [1]. On the surface of the pebbles tritium accumulates in T^+ form, due to the interaction with radiation defects and products of radiolysis [2]. This effect could be explained by the fact that a radiation unstable Li_2CO_3 phase forms in chemisorbing process of carbon dioxide from air atmosphere [3,4,5]. The aim of the investigation was to estimate the influence of chemisorption products of CO_2 on the radiolysis of Li_4SiO_4 containing ceramic.

Lithium orthosilicate powder with relevant composition was selected as investigation material because of the high specific surface area and small grain sizes ($S_{\text{spec.}}=17\pm2 \text{ m}^2\cdot\text{g}^{-1}$, $\varnothing_{\text{powd.}}=350\text{-}550 \text{ nm}$). The powder was thermally treated ($T_{\text{max}}=300^\circ\text{C}$, $t_{\text{max}}=1 \text{ h}$, air atmosphere) to accumulate chemisorption products of CO_2 [6], and irradiated with gamma rays (absorbed dose 56 kGy , dose rate $14 \text{ kGy}\cdot\text{h}^{-1}$). The composition of the powder was analyzed with powder X-ray diffractometry, Fourier transformation infrared spectroscopy and thermal analysis, the accumulated radiation defects were studied with electron spin resonance spectroscopy.

It was established that X-ray amorphous chemisorption products of H_2O and CO_2 , mostly LiOH and Li_2CO_3 , accumulate on the surface of Li_4SiO_4 powder after thermal treatment in air. Radiation defects of Li_2CO_3 and LiOH are unstable and accumulate only in low amounts. Radiolysis of chemisorption products affects the radiation stability of Li_4SiO_4 powder and increases the concentration of radiation defects of silicates, SiO_4^{3-} and SiO_3^{3-} , up to 50%. On the basis of the obtained results it was concluded that a Li_2CO_3 containing layer on the surface of Li_4SiO_4 pebbles can reduce the radiation stability and may cause tritium accumulation. It may be favourable to change the ceramic composition and to replace Li_2SiO_3 as secondary phase by a less reactive and radiation stable phase like Li_2TiO_3 [7].

References:

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