thermodynamic tritium inventories of Li_2O are sufficiently small under an ambient tritium vapor pressure.

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Response to "Comments on the Tritium Solubility in Lithium Oxide as a Solid Tritium Breeding Material"

In the context of the STARFIRE study,[1,2] I developed models to estimate tritium inventories in solid blankets. A major uncertainty was the relationship between tritium concentration in the solid and the gas phase, analogous to the Sieverts' constants for hydrogen-metal systems. In the absence of definitive experimental data, it was assumed that bred tritons are dispersed in the oxide lattice, along with the lithium ions. The tritium was then treated as a solution of LiOT in Li_2O. Recent comments by Nasu et al.[3] express doubt that LiOT is soluble in Li_2O, owing to quite different crystal structures.

The question is whether neutron irradiation of Li_2O produces a separate phase of LiOT (having unit activity) or whether the tritium atoms are more uniformly dispersed in the oxide lattice, substituting for lithium atoms. Specifically, does the bred tritium in Li_2O have unit activity in the solid?

This question can only be answered by experimentation. Nasu et al.[3] indicate some preliminary data with 0.4 wppm tritium in equilibrium with an unspecified T_2O (or HTO) pressure. The H_2O pressure (48.5 Pa) could be in equilibrium with LiOH in the solid. However, the data are not complete enough to demonstrate that LiOT is a separate phase.

I would suggest that a simple test could answer the critical question. If the LiOT is in solution in Li_2O, then one would expect the addition of LiOH to the solid (or H_2O to the gas in equilibrium with the solid) would *increase* the tritium overpressure because $p(\text{HTO}) \approx Kp \cdot a(\text{LiOH}) \cdot a(\text{LiOT})$. If, however, the total hydroxide phase has unit activity, then the total water pressure (H_2O + HTO + T_2O) would be independent of the amount of hydroxide (LiOH + LiOT) if the LiOH and LiOT are mutually soluble. Thus, addition of H_2O or LiOH would be expected to *decrease* the amount of tritium in the gas phase.

It is quite possible that the true situation may be intermediate between the two idealized cases. The tritium may show some solubility in the solid. The final answer awaits definitive experimental results.

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[1] C. C. BAKER et al., "STARFIRE–A Commercial Tokamak Fusion Power Plant Design," ANL/FPP-80-1, Argonne National Laboratory (1980).

[2] R. G. CLEMMER, "The Development of Tritium Breeding Blankets for D-T Burning Fusion Reactors," *Proc. Fourth ANS Topl. Mtg. Technology of Controlled Nuclear Fusion,* King of Prussia, Pennsylvania, October 14-17, 1980, U.S. National Technical Information Service (1981, to be published).

[3] S. NASU, T. TANIFUJI, and H. TAKESHITA, *Nucl. Sci. Eng.,* **78**, 193 (1981).