§5. Hydrogen Solubility of FLiNaK Containing Nano-Ti Powder

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Molten salts are hopeful liquid breeding material for fusion reactor because of the inertness against air and water, low electric conductivity (no MHD pressure drop in the strong magnetic field), relatively light density, good compatibility with structure materials. However its very low hydrogen isotopes solubility, which will result in high equilibrium tritium pressure and severe tritium permeation leakage in the actual fusion reactor, is a great concern.

Considering this, mixing small amount of hydrogen soluble metal powder (such as Ti, Zr) with molten salt has been proposed [1]. It is expected to results in higher effective hydrogen solubility, no significant change in electric resistivity, negligible change in nuclear behavior (=TBR), and improved compatibility with structure materials when fluoric acid (=TF) is generated. The increase of effective hydrogen solubility has already been confirmed using Ti powder below 45 μ m in diameter [2].

In this work, effective hydrogen solubility of nano-Ti powder containing FLiNaK was investigated. Nano-Ti powder, 0.1wt.% in FLiNaK, was directly produced in FLiNaK by the plasma-induced discharge electrolysis method [3] (I'MSEP Co., Ltd, Japan).

Experimental setup is shown in Fig.1. Absorbed hydrogen by H_2/Ar gas bubbling in the mixture was swept by pure Ar gas bubbling and quantified using a gas chromatography. Fig.2 is an example of hydrogen release behavior from FLiNaK with and without nano-Ti powder. The ratio of absorbed hydrogen to titanium powder was calculated and shown in Fig.3 with our previous work's result. Hydrogen solubility in nano-Ti mixed FLiNaK was almost 4 orders of magnitude higher than that of pure

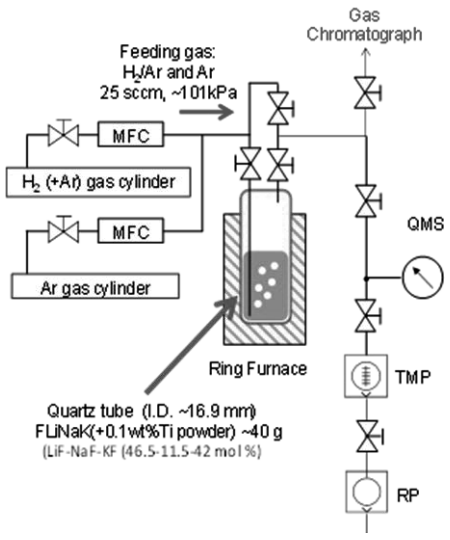

Fig.1. Experimental setup.

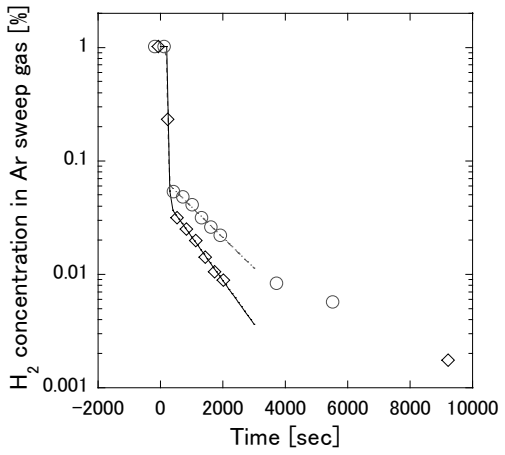

Fig.2 Hydrogen release behavior of FLiNaK and Ti-containing FLiNaK at 973K
Diamond and solid line: pure FLiNaK
Circle and dashed line: Ti-mixed FLiNaK

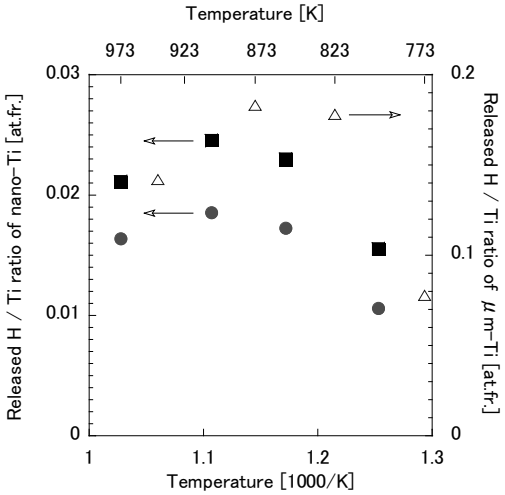

Fig.3. Released hydrogen from the Ti powder
Circle: nano-Ti from 500~3000 sec
Square: nano-Ti from 500~∞ sec
Triangle: μm-Ti charged by 5-kPa H2 gas [2]

FLiNaK and its temperature dependence was similar to that of μm-Ti powder mixed one [2].

Additionally, pure vanadium plate immersed in this Ti-mixed FLiNaK showed smaller hydrogen buildup in hydrogen containing gas condition, than that in pure FLiNaK and in μm-Ti mixed FLiNaK.

A part of these results were presented in a conference (ITC2015, Toki) and detailed information is to be published in a journal [4].

1) A. Sagara et al., Fusion Eng. Des. 89, 2114 (2014).
2) J. Yagi et al., Fusion Eng. Des. 98, 1907 (2015).
3) Y. Ito et al., Molten Salts Chemistry: From Lab to Applications, 269 (2013).
4) J. Yagi et al., Plasma Fusion Res., accepted