NITRIDES AS TRITIUM BARRIER MATERIALS FOR BLANKET SYSTEM

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Molten salt is known as a promising coolant material for Force Free Helical type Reactor (FFHR) with self-cooled liquid blanket system [1]. It has attractive advantages on safety aspects: low tritium solubility, low reactivity with the air and water, low pressure operation, and low MHD resistance. LiF-BeF_2 (Flibe) is especially focused on as tritium (T) breeder and coolant of the blanket due to inherent safety and high thermal efficiency in operation above 500˚C.

LiF-NaF-KF (Flinak) also possesses similar chemical characteristic to that of Flibe. Since it is easy to carry out laboratory experiments due to beryllium free, it is allowed to be used as a simulant for the heat and mass transfer investigation. Flinak would also one of alternative candidates of the coolant and tritium breeder of the blankets. For the blanket system, the developments of tritium barrier, tritium recovery system and heat exchanger are key issues. In the heat exchanger, the permeation of tritium to secondary coolant loop must be inhibited by the tritium barrier. And deterioration of heat transfer efficiency of the heat exchanger by the barrier must be prevented concurrently.

We reported that the chemical stability of AlN, Y_2O_3, Er_2O_3 and Al_2O_3 in Flinak was studied by corrosion test [2]. AlN was promising as a tritium barrier material because of better compatibility with Flinak than the others. In the next stage, the coating process on the surface of structural materials such stainless steel and low activation steel is required for the development of the components for the system. The purpose of the present study is to develop the nitriding of the structural material and to investigate the heat and mass transfer of the metal nitride coated structural material.

Nitriding treatment of the aluminized JLF-1 steel which is one of the structural materials was performed by glow discharge nitriding. Figure 1 shows an image of cross section of the specimen by scanning electron microscopy (SEM). According to electron probe microanalysis (EPMA), the surface was coated with aluminum nitride layer (Table 1). Considering usage and maintenance of structural components in contact with molten Flibe or Flinak in the blanket system, nitriding treatment in molten Flinak would be more advantageous in self-healing than other nitriding treatments. Application of the electrochemical nitriding method which has been developed in LiCl-KCl molten salt [3], [4] was also considered. In addition to these, thermal conductivity, hydrogen permeability and electrical conductivity of the nitride coated specimens will be reported.

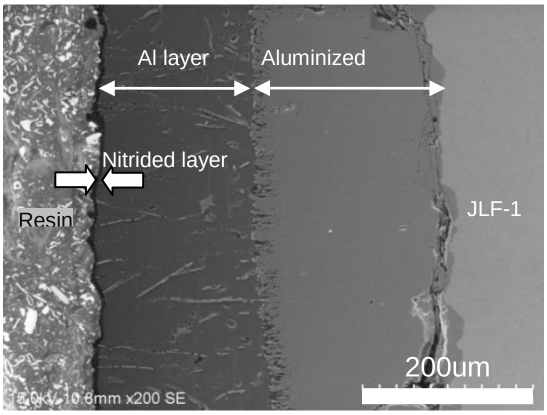

Figure 1. SEM image of a nitrided JLF-1 specimen after aluminizing. The surface was covered with aluminum nitride layer about 2 micrometers.

Table 1 chemical composition at the surface of nitride JLF-1 specimen after aluminizing

Elements	Fe	Cr	O	N	W	Al
Atomic ratio %	4.54	0.41	32.3	7.86	0.05	54.9

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