§68. Basic Study on Surface Chemical Combination between Beryllium Metal and Hydrogen Isotope Gas (II)

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Beryllium has been utilized as a moderator and/or reflector in a number of material testing reactors. Beryllium is also supposed to be widely used in fusion reactors as neutron multiplier and protective walls of plasma facing components. It is important to perform the characterization of the different grade beryllium such as the productivity, mechanical and chemical properties and the interactions under water and/or gas environment. In this study, three kinds of beryllium were prepared and corrosion test of these beryllium samples were carried out for life time expansion under pure water.

The properties of three kinds of beryllium samples are shown in Table 1[1]. S-200F is the reference material as the reflector in testing reactors. S-65H was tested due to its higher purity and better isotropy than S-200F, and I-220H was tested due to its higher mechanical strength and better isotropy than S-200F. The corrosion test was carried out under pure water at 50˚C up to 8300 h. In the test, water analysis was carried out during the corrosion test by the pH/conductivity meter. The surface interactions of these beryllium samples were also evaluated by X-Ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS) and electric conductivity measurement.

In the corrosion test, the pH of water in the vessel installed Be samples was almost 6 at a stationary value. The conductivity increased gently and the value was about 400μS/m. During the corrosion test, the white product was generated on the surface of each Be sample. The (100), (002) and (101) peaks of beryllium were observed in each Be sample. These peaks of each Be sample decreased after the corrosion test and the decrease of peaks in S-200F was larger than that in I-220H.

The weight change of S-200F was larger than that of I-220H after the corrosion test. Figure 1 shows the change of electric conductivity of each Be sample. Ratio of electric conductivity of S-200F was larger than that of S-65H and I-220H. The conductivity of I-220H was almost no change. From these results, the corrosion properties were evaluated by the measurements of weight change and electric conductivity and influenced by the content of BeO and grain size of each Be sample.

The XPS spectrum of Be1s of each Be sample before/after the corrosion test is shown in Fig.2. One peak in about 112eV was observed in each Be sample before the corrosion test. On the other hand, two peaks in about 110 and 112eV were observed after the corrosion test. From the result, the surface change of each Be sample occurred after the corrosion test.

In conclusion, the surface change of each Be sample was observed by the corrosion test and influenced by the content of BeO and the grain size of the beryllium grades. In future, the corrosion mechanism of beryllium samples will be investigated from the results of XPS measurement.

Table 1 Properties of beryllium samples

Material	Beryllium Metal		
Grade	S-200F	S-65H	I-220H
Shape (mm)	ϕ10x1.5	ϕ10x1.5	ϕ10x1.5
Density (g/cm³)	1.855	1.848	1.861
Grain size (μm)	10.3	6.9	5.6
Element (%)			
Be	99.00	99.40	98.60
BeO	1.00	0.70	1.90
O	-	-	-
Al	0.05	0.04	0.01
Fe	0.12	0.08	0.06
Si	0.03	0.02	0.02

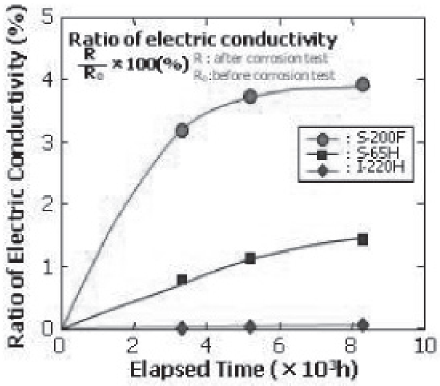

Fig. 1. Change of electric conductivity of each Be sample during corrosion test.

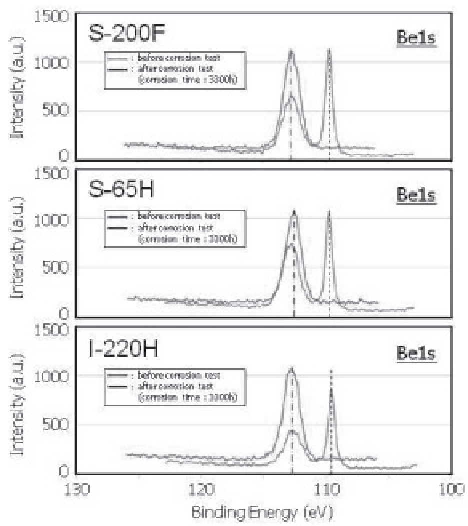

Fig. 2. XPS spectrum of Be1s of each Be sample before/after the corrosion test.

1) Tsuchiya, K.: Annual Report of NIFS, (2011) p.545.