Development of Metal Catalyst Impregnation Technology for Membrane-based Oxygen Removal System

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1. INTRODUCTION

Dissolved oxygen(DO) is a primary cause of PWSCC and its content in reactor coolant system in NPPs has been strictly controlled by various DO removal methods. There are several removal methods of DO, such as vacuum degasification, thermal deaeration, and reductive removal by oxygen scavengers. Although the operation principles of vacuum degasification and thermal deaeration are simple, these methods require a lot of energy for operation and show lower efficiency. And these methods have a few handicaps such as temperature, pH, toxicity, high cost of installation and so on. For the purpose of developing the best method for DO removal from make-up water storage tank, it is necessary to overcome the disadvantages of hydrazine treatment. From this point of view, membrane-based oxygen removal system (MORS) has many advantages than other methods for example, friendly environmental process, versatility of operation conditions with high temperature and low pressure, small space, low cost, etc. Recently de-gassing membrane is widely used in power plant's feed water system for DO removal. De-gassing membrane has some advantages; it removes other dissolved gases such as CO2, N2, as well as O2, and is more economical than Catalytic resin-based Oxygen Removal System. In this study, to obtain better efficiency of MORS, we modified the polypropylene (PP) hollow fiber membrane by plasma treatment and ion beam irradiation supported platinum(Pt), palladium(Pd) as metal catalyst on the surface of the membrane.

2. EXPERIMENTAL

1) Metal Catalyst Impregnation through Ion Beam Treatment

Ion Beam Treatment is a method where ion sources of inert gases such as Ar, Kr, Xe that are the source of Kaufman in reforming the object material's surface, and in this study, the hydrogen atoms that are present in the PP's surface were hit by ion source thereby activating the surface and later the Pt metal was sputtered onto the surface. Ar ion source was used in this process, and the size of the Pt target was 6 inches in diameter and 0.5mm in thickness. Fig. 1 illustrates the mechanism of the reaction.

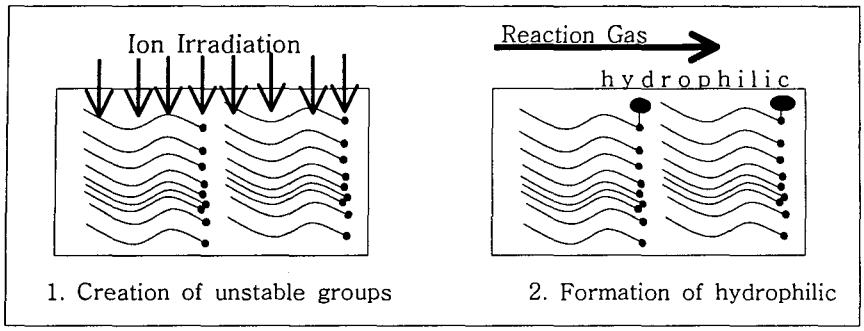

Fig. 1 Activation Mechanism by Ion Beam Treatment

2) Metal Catalyst Impregnation through Plasma Treatment

In the Impregnation method of metal catalyst through plasma treatment, the surface is activated by producing radicals on the plasma discharge and here the metal catalysts are impregnated. Plasma Treatment that are used In this study is dielectric barrier discharge (DBD) of the atmospheric pressure. Silicon, rubber, and glasses are used as a dielectric barriers. To increase the effect of surface treatment, air, argon and helium were used as ambient gas. Fig. 2 illustrates the outline schematics of the plasma treatment

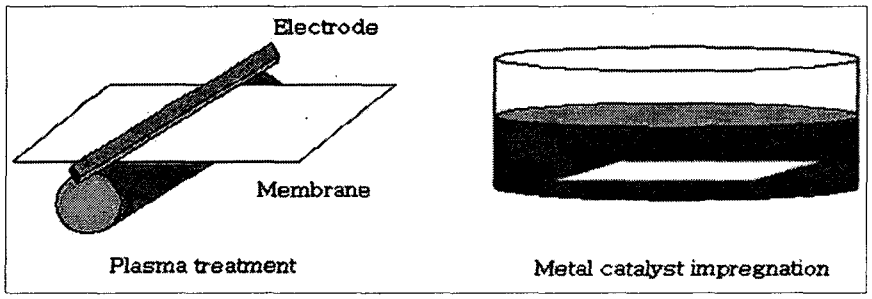

Fig. 2 Outline schematics of metal catalyst impregnation through plasma treatment

3. CONCLUSION

PP membrane's surface was treated with the Ion Beam and Plasma Treatment and then the metal catalyst was impregnated on the surface. Those that were not impregnated underwent thermo analysis and tensile strength test with the impregnated PP membrane. And to confirm the shape and result of the metal catalyst impregnation, SEM was used to investigate the surface and the section. By examining each results, in both treatments, there were no changes in the PP membrane's thermal characters, however, there were slight deteriorations in the mechanical characters. In both the treatment, metal catalysts were successfully impregnated from the surface of the PP membrane.