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Characteristics of hydrogen permeation by pulsed plasma membrane reactor

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Highlights

1. Plasma membrane reactor (PMR) was developed to obtain pure H_2 for fuel cells. H_2 was separated by the PMR without heating control.
2. Hydrogen permeability of 80% was attained by the PMR at applied voltage of 14 kV.

Abstract

To develop a high efficiency hydrogen production device, pulsed plasma reactor with hydrogen separation membrane (PMR) was equipped. In this study, fundamental characteristics of the PMR were investigated by variation in the flow rates, difference pressures, and applied voltage of plasma.

Fig. 1 shows the configuration of the PMR and the experimental setup. The PMR consisted of a glass tube and a hydrogen separation membrane module, which were a palladium alloy membrane of 20 μm thickness. Approximately 100% hydrogen gas was fed to the PMR at atmospheric pressure or pressurized conditions, and plasma was fired. The flow rate of separated hydrogen was measured at exit of the membrane.

Fig. 2 shows the hydrogen separation characteristics of the PMR. It was found that the hydrogen permeation occurs in the PMR without heating. In general, the hydrogen permeation is required temperature of 350—400 ºC.[1)] Hydrogen permeation mechanism in the PMR was considered as follows.

1) H radicals are generated from molecular hydrogen by electron impact in plasma, 2) and they are adsorbed on the surface of the membrane. 3) H radicals are diffused in the membrane, 4) and H_2 was generated by recombination of H radicals.

H_2 permeability of 80% was attained by the PMR at applied voltage of 14 kV at the hydrogen flow rate of 1.0 L/min at no heating.

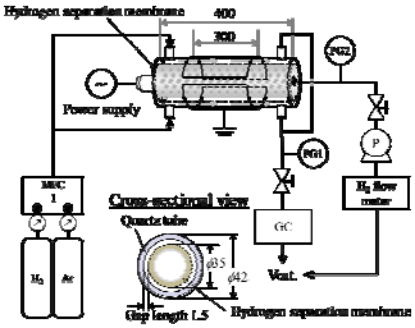


Fig. 1 Configurations of plasma membrane reactor and the experimental setup.

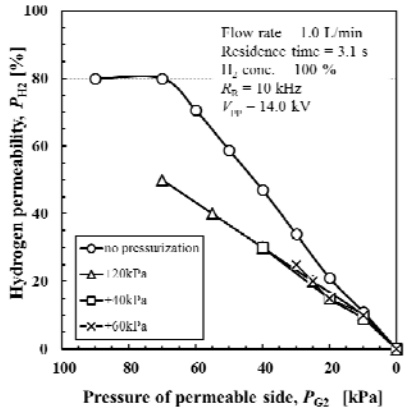
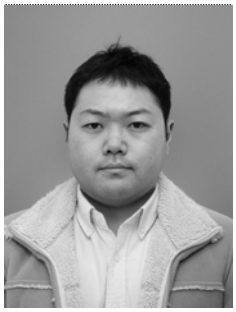


Fig. 2 Hydrogen separation characteristics of PMR at various differential pressure.



References

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