

Novel Hydrogen Probe for Al Melt

C.O. Park¹, Young Chang Yang², B. Jung³

¹ Dept. of MSE, KAIST, Daejeon, KOREA

Email: cops@kaist.ac.kr

² Samsung Electronics

³ Dept. of MSE, KAIST, Daejeon, KOREA

Abstract

These days the use of Al is ever-increasing as a building block for construction as well as aerospace industry and electronic home appliances because of its high strength with light weight and good surface appearances. However as the strength of the Al alloy increases, it is more susceptible to hydrogen which is incorporated in the melt through the decomposition of the humidity in the ambient[1]. The object of this study is to achieve a stable electrochemical hydrogen sensor which can be used in a harsh environment of Al alloy melts.

Key words: Hydrogen sensor, Proton conductor, Titanium, $\text{CaZr}_{0.9}\text{In}_{0.1}\text{O}_{3-\delta}$

Experiments

The high temperature proton conductor of $\text{CaZr}_{0.9}\text{In}_{0.1}\text{O}_{3-\delta}$ was used to fabricate the sensor of Eq. (1) due to its high mechanical strength and high chemical stability. The schematic structure of the sensor is shown in Fig.1 with its optical images where the reference materials of TiH_2/Ti [2,3] has been used.

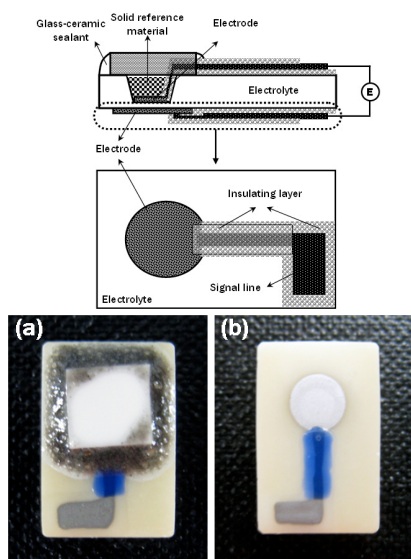
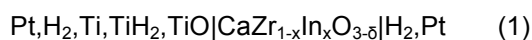


Fig. 1. Schematic view of the hydrogen sensor; (a) Top view (b) Bottom view.

Results

The fabricated sensor has been measured for various hydrogen concentrations (0.1% to 10%)

at temperatures ranged from 723K to 1123K in Fig. 2(a). It shows sensitivity of more than 99% of theoretical value at more than 923K and about 95% at 723K to 823K as shown in Fig. 2(b).

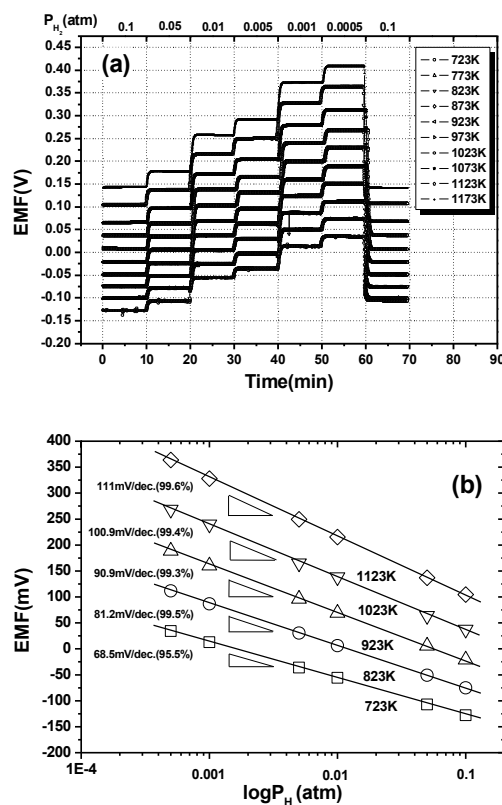


Fig. 2. EMF responses of the hydrogen sensor at various temperatures; (a) transient behaviors as a function of hydrogen concentration and (b) their sensitivities.

Conclusions

The hydrogen sensor made of In doped CaZrO_3 electrolyte and the solid reference material of $\text{Ti/TiH}_2/\text{TiO}$ exhibits the hydrogen concentration-dependent response of EMF with a speed of less than 40 seconds at 500 to 900°C, having almost Nernstian sensitivity. It gives reproducible results for about 60 hours continuous use in the controlled hydrogen atmosphere.

References

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