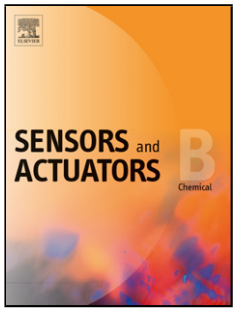

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Research Highlights

This is the response to the comment on the article "New solid-state electrochemical method of measuring dissolved hydrogen in Al melt" by S.H. Kim, B.H. Jung, C.O. Park, R.A. Rapp.

Abstract

Our publication by Kim el al. [7] is not purposed to criticize others but we try to deliver the problems that the current sensor has. In fact, I think that we have studied all types of sensor structure for Al melt since 2002 and experienced many problems mentioned in the paper. I hope that this discussion will be a good chance to widen the technical understanding in proton conductor type hydrogen sensor, which leads to a completeness of sensor performance.

Keywords

Sensor, solid electrolyte, proton, Hydrogen, Aluminum

1. History of the hydrogen sensor in Al industry

There are a few non-electrochemical methods and systems to measure the hydrogen concentration dissolved in liquid aluminum[1]: 1 vacuum extraction of hydrogen from a solidified sample, 2. A nitrogen carrier gas equilibration with such a solidified sample, with detection of concentration via a thermal conductivity measurement, 3. A closed loop recirculation technique where a carrier gas is passed through and collected from a melt until its measured hydrogen content become constant. Commercial variations on the last technique are marked by ABB(Alscan)[2]. However, these non-electrochemical methods are slow, cumbersome, and expensive compared to the electrochemical probe.

Iwahara et al.[3] were the first who adopted the solid state electrochemical method to measure the concentration of hydrogen in Al melt. They designed the type I potentiometric hydrogen sensor, adopting a gas reference system (shown in Fig. 1(a)) that was on the market as a commercial sensor(NOTORP model KYHS-A1 of TYK corporation). Later, the gas reference had replaced with solid mixture of Ti, TiO and TiHx by Rapp et al. [4-5] as shown in Fig 1(b). The same type of structure with Zr/ZrHx reference was commercialized by Schwandt [6] to launch AlspekH in the market. This structure has further improved by adopting oxygen reference electrode of