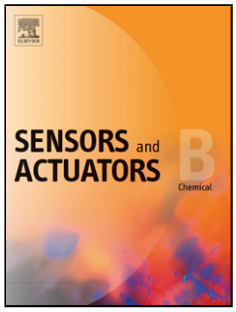

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Development and Testing of an Electrochemical Methane Sensor

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Abstract

In this article, the development of an electrochemical methane sensor is presented. The mixed potential based sensor is based on tin doped indium oxide (ITO) and platinum electrodes and yttria-stabilized zirconia (YSZ) electrolyte. The sensor was fabricated using the inexpensive tape-cast method. The sensor responded to methane with a response time of 15 s. The staircase response to methane indicated a 44 mV sensor response to 100 ppm of methane. The sensor response indicated a log-linear relationship with the methane concentration. Upon 500 hrs of sensor testing, a 5% reduction in methane sensitivity was observed. The cross-sensitivity study on the sensor indicated minimal interference to NO, NO_2, and CO_2. To improve the sensitivity to methane, a signal conditioning method referred to as the pulsed discharge technique (PDT) was applied. A fourfold increase in methane sensitivity was observed when the sensor was subjected to PDT. Future studies include the miniaturization of the sensor with integrated heater design.

Keywords: Methane, Gas Sensor, YSZ, ITO, Electrochemical, Mixed potential

1. Introduction

Natural gas is the most widely consumed energy source in American homes. It is used for furnaces, water heaters, stoves, fireplaces and clothes dryers. Although, natural gas burns cleaner than coal, uncombusted methane leaks from the piped lines or valves erases some of the carbon advantage that natural gas has over fossil fuels at the point of combustion [1]. When unburned methane escapes into the atmosphere, it is a greenhouse gas 20 times more powerful than carbon dioxide. Further, methane emissions result from leaks and routine venting during the production, processing and transportation of natural gas [2].

Unburned Methane, in general, is very stable. But mixtures of methane and air, with the methane content between 5 and 15% by volume, are explosive. Hence, methane sensors are required for the