September 1970 Brief 70-10419

NASA TECH BRIEF

Thin Film Devices Used as Oxygen Partial Pressure Sensors

The use of thin films of zinc oxide to measure the oxygen pressure of specific environments as a function of conductance is relatively new. The method is useful in that the simplicity, low power, and large dynamic range will allow improved pressure sensing. This information should prove interesting to industries involved in monitoring or detecting oxygen levels at high temperatures.

The research effort centered in two major areas: preparing and characterizing zinc oxide and tin oxide films to be used for oxygen sensing elements; and designing and constructing a laboratory model suitable for evaluating thin films for sensing oxygen partial pressure.

Zinc oxide films were successfully prepared at elevated temperatures and studied experimentally and theoretically. Their electrical conductivity was measured as a function of temperature, oxygen partial pressure, and other atmospheric constituents. The time response following partial pressure changes was also studied as a function of temperature and environmental changes. Using the results, an oxygen partial pressure sensor was fabricated utilizing zinc oxide films.

Tin oxide doped with zinc was also investigated and found to be sensitive to oxygen partial pressures at temperatures less than 300°C. The tin oxide films exhibited more instability than films of zinc oxide, but had much shorter response times. Due to the difficulty in preparing the zinc doped tin oxide films and their instability, further effort in this area was discontinued in favor of the more promising zinc oxide films.

To illustrate the feasibility of using thin films as oxygen sensing elements, a laboratory model was fabricated and evaluated. The oxygen partial pressure sensor consisted of a heater, electrical readout, and temperature controller. The entire unit required approximately seven watts of power.

In testing the laboratory model, no failures were observed indicating a sensor lifetime of several months. The use of thin films as oxygen sensors made it feasible for the sensing head to be very small and lightweight. The sensing head for the laboratory model weighed approximately 30 grams and occupied 30 cm^3.

Additional laboratory models proved to be rugged, stable, and capable of a wide sensing range of oxygen partial pressures from less than 1 mm Hg to greater than one atmosphere. Time constants of approximately one minute were possible, and a 63 percent value of the oxygen partial pressure was obtained.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-CR-1182(N68-35149), An Investigation of Thin Film Oxygen Partial Pressure Sensors

Patent status:

No patent action is contemplated by NASA.

Source: K.S. Canady and J.J. Wortman of
Research Triangle Institute
under contract to
Langley Research Center
(XLA-06473)

Category 04