Monitoring Thermocouple Usage

NEW DEVICE INDICATES WHEN RE-CALIBRATION REQUIRED

The precise control of temperature during manufacturing processes has assumed an increased importance in recent years. Particularly within the semiconductor industry, this has arisen as more complex devices and higher product yields have been sought. For example, during the processing of silicon wafers the stages of diffusion and epitaxial growth are carried out under very strictly controlled conditions. Diffusion furnaces used during these stages require not only accurate control to within narrow limits, but also the maintenance of temperature profiles. In the past, the measurement of profiles was carried out using single junction thermocouples, although the use of multi-junction assemblies is increasing and more recently such assemblies are being used for direct furnace control.

To achieve the precise control of temperatures, noble metal thermocouples are generally employed because of the accuracy to which they can be calibrated and their stability in service. While both these factors are important, stability presents users with the greater imponderable. Calibrations can be carried out to high degrees of accuracy in laboratories approved by the British Calibration Service, such as the Calibration Laboratory of Johnson Matthey Metals Limited, where standards are traceable to those of the National Physical Laboratory. The stability of thermocouples, on the other hand, is relative, as all thermocouple types are subject to drift during use as shown in Figure 1 and therefore require re-calibration from time to time.

In the past obtaining a reliable guide to the need for re-calibration has proved difficult, not only because the rate of drift is dependent upon the environment, although this variable can be much reduced by the use of a suitable sheath, but also because of the problems associated with monitoring temperatures and lengths of time of thermocouple usage. Such problems have led the operators of processes depending upon precise temperature control to adopt one of two practices. Either thermocouple usage is monitored continuously by sampling the temperature at frequent intervals under computer control and processing this information to give an estimate of accumulated drift, or thermocouples are re-calibrated or replaced at pre-set intervals of time. The first approach is expensive and requires an extensive knowledge of drift characteristics under conditions of time and temperature, while the second is somewhat arbitrary.

To help overcome the problems of deciding when to re-calibrate thermocouples, Johnson

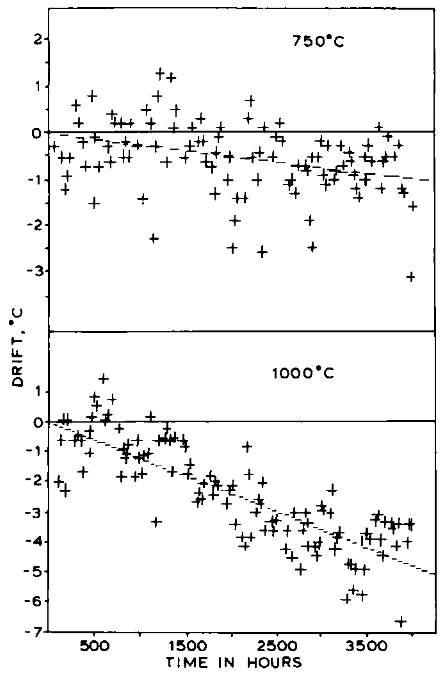

Fig. 1 The drift characteristics of platinum versus 10 per cent rhodium-platinum thermocouples in air at temperatures of 750 and 1000°C. The points represent individual calibrations and the blue lines are a least squares fit

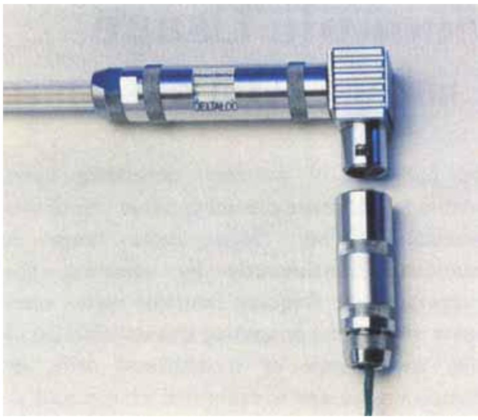

Fig. 2 The DeltaLog device, shown fitted to a modified Lemo connector of a 3-junction profiling thermocouple, is battery driven and completely self contained

Matthey Metals have developed a small electronic device named DeltaLog which can form an integral part of their range of quartz sheathed multi-junction thermocouples. Housed within the end connector, the device monitors the time and temperature of thermocouple usage and indicates when re-calibration is necessary.

The indicator consists of a small dot within a glass tube which moves along an adjacent scale at a rate determined by the temperature of usage. When the dot has reached full scale deflection, thermocouple re-calibration is recommended.

A DeltaLog device fitted to a modified Lemo connector of a 3-junction profiling thermocouple is shown in Figure 2. It is completely self contained, being driven by a battery inserted into the device immediately prior to despatch, giving an active life of approximately one year. Thermocouples returned to the Calibration Labratory of Johnson Matthey Metals Limited are checked and re-calibrated while the DeltaLog indicator is re-set to zero and a new battery inserted in preparation for further use.

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Acknowledgement

DeltaLog is a Trademark of Johnson Matthey, registration and patents have been applied for.

The Published Platinum Metal Alloy Systems

Phase Diagrams of Precious Metal Alloys, COMPILED BY HE CHUNXIAO, MA GUANGCHEN, WANG WENNA, WANG YONGLI AND ZHAO HUAIZHI, The Metallurgical Industry Press, People's Republic of China, 1983, 301 pages, U.S. $6.66

Knowledge is of only limited value to society unless it is accessible to all those who can understand and make use of it; indeed it was to make information on the fundamental properties and industrial applications of the platinum group metals more readily available that *Platinum Metals Review* was founded by Johnson Matthey in 1957. Since that time many studies of these metals have been made but, unfortunately, much of the established data still remains widely, and inconveniently, dispersed throughout the literature.

To overcome this difficulty in a particularly important area of materials science a group of colleagues under the guidance of Professor Tan Qinglin, Director of the Institute of Precious Metals, at Kunming in the People's Republic of China, has collected together the phase diagrams of all alloy systems containing the so-called precious metals published up to the end of 1975. Over 500 systems are presented in this book, including 199 binary, 115 ternary and five quarternary systems that contain a platinum group metal.

In view of the rate of progress in this aspect of physical metallurgy none of the diagrams has been evaluated or reviewed; despite this the publication is a most useful addition to the literature on the platinum group metals. Although nominally in Chinese, English translations are given wherever this is required.

The contents pages list systems in alphabetical order according to the chemical symbols of the component elements. Interestingly, the compilation has enabled gaps in the knowledge to be identified; even among binary systems phase diagrams of rhodium, iridium, osmium and ruthenium are still rather scarce.

This important work may be obtained from the China National Publishing Industrial Trading Corporation, P.O. Box 614, Beijing, People's Republic of China.

I.E.C.