P. Köpf-Maier of the University of Ulm and H. Köpf of the Technische Universität, Berlin. In contrast to the preceding tome, this 23 page section is concerned with knowledge which has been accumulated during a period of only about twenty years. The progress made in this time is remarkable, and one may anticipate that a later Gmelin supplement will have to devote a more lengthy section to this important topic.

In the main, this handbook covers the literature up until 1983, and its importance results from the many relevant sources referenced. These also serve to indicate the publications that should be searched by investigators requiring more recent information. At the front of this book a list is given of other Gmelin volumes on the platinum group metals. These are likely to emphasise work regarded as particularly significant up to the time of their publication, and they are tabulated here for the benefit of readers who may wish to study other aspects of platinum group metals chemistry.

Determining the Freshness of Fish

There is an obvious requirement that food for human consumption should be fit for the intended purpose, and producers, processors and distributors all have considerable responsibility for this. In Japan fish form a particularly important part of the diet, and there is therefore a special interest in ensuring that their quality can be monitored accurately. During the past year two communications from researchers in the Department of Materials Science and Engineering, at Nagasaki University, have reported the development of a sensor capable of determining the freshness of fish (1, 2).

Fish freshness can be expressed by the K value, this being defined as the percentage of inosine and hypoxanthine present among the adenosine triphosphate related compounds in fish muscle. However, the process of determining this data is destructive, and requires considerable time and effort.

After death the quality of fish deteriorates, and as it does gaseous species are given off including trimethylamine, the concentration of which increases significantly as the freshness decreases. Thus there is a possibility of determining the freshness of fish by monitoring changes in the concentration of emitted trimethylamine, and this led the Nagasaki University team to develop semiconductor gas sensors that were highly sensitive to trimethylamine. Initially stannic oxide, a typical semiconductive metal oxide, was employed, either on its own or with additions of palladium, ruthenium or gold. This sensor material was applied to the outer surface of an alumina tube on which two gold electrodes were printed, and which could be heated to a given temperature by means of a small nichrome coil inserted in the tube. Gas sensitivity, defined as the ratio of the electrical resistance of the sensor in dry air to that in a sample gas, was measured in a flow apparatus. Of the sensor materials studied the one containing ruthenium was found to be the most sensitive to 300ppm of trimethylamine, at a temperature of about 555°C.

Subsequent work to develop more sensitive sensor materials involved zinc oxide, tungsten oxide and titanium oxide, both on their own and with the addition of 0.5 weight per cent ruthenium. The maximum sensitivity to 300ppm trimethylamine in a sample gas was exhibited by the titania element containing ruthenium.

Following this finding the investigators went on to demonstrate the suitability of this element for monitoring the freshness of the fish known as Japanese saurel. The electrical resistance changes of the sensor element, held at a temperature of 555°C, continuously monitored the condition of the fish which was stored in a closed box at room temperature, while gas chromatography confirmed that trimethylamine was among the gaseous species emitted. For comparative purposes the K value of similar fish stored under the same conditions was determined by analysis of the adenosine triphosphate related compounds in the fish muscle. This interesting work confirmed that resistance changes of a ruthenium/titania sensor element could sensitively and selectively detect trimethylamine, thus demonstrating the potential of this method for rapidly and non-destructively monitoring fish freshness.

References

1 M. Egashira, Y. Shimizu and Y. Takao, *Chem. Lett. Jpn.*, 1988, (3), 389

2 M. Egashira, Y. Shimizu and Y. Takao, *J. Electrochem. Soc.*, 1988, **135**, (10), 2539