studies using a diesel engine. Diesel engines have inherently low hydrocarbon emissions and injection of hydrocarbons into the exhaust stream was necessary to obtain significant nitrogen oxides conversion.

Finally, a complete automotive emission control catalyst system must have adequate hydrocarbon and carbon monoxide activity in addition to nitrogen oxides removal. The catalyst systems described above show deficiencies in hydrocarbons and, particularly, carbon monoxide activity which would require the use of a dual function catalyst system. The first component would be the selective nitrogen oxides reduction catalyst, followed by a conventional platinum group metal catalyst for hydrocarbons and carbon monoxide removal. Such concepts are already described in the patent literature. It is obvious that a practical selective nitrogen oxides reduction catalyst for automotive applications is some time away, but the exciting results obtained in the past several years and the high level of activity in this area are reasons for encouragement.

References

1 R. A. Searles, *Platinum Metals Rev.*, 1988, **32**, (3), 123

2 B. J. Cooper and S. A. Roth, *Platinum Metals Rev.*, 1991, **35**, (4), 178

3 B. Harrison, B. J. Cooper and A. J. J. Wilkins, *Platinum Metals Rev.*, 1981, **25**, (1), 14

4 *Off. J.*, 30th August 1991, **34**, L242

5 B. Harrison, M. Wyatt and K. G. Gough, "Catalysis", Vol. 5, R. Soc. Chem., London, 1982, pp. 127–171

6 J. W. Hightower and D. A. VanLeirsburg, in "The Catalytic Chemistry of Nitrogen Oxides", ed. R. L. Klimisch and J. G. Larson, 1975, Plenum Press, New York, p. 63

7 B. Harrison, A. F. Diwell and M. Wyatt, *Platinum Metals Rev.*, 1985, **29**, (2), 5

8 M. Iwamoto, S. Yokoo, K. Sakai and S. Kagawa, *J. Chem. Soc., Faraday Trans.*, 1981, **77**, 1629

9 M. Iwamoto, H. Yahiro and K. Tanda, "Successful Design of Catalysts", ed. T. Inui, Elsevier, Amsterdam, 1988, pp. 219–226

10 M. Iwamoto and H. Hamada, *Catal. Today*, 1991, **10**, 57

11 Y. Li and W. K. Hall, *J. Phys. Chem.*, 1990, **94**, 6145

12 Y. Li and W. K. Hall, *J. Catal.*, 1991, **129**, 202

13 S. Sato, Y. Yu-u, H. Yahiro, N. Mizuno and M. Iwamoto, *Appl. Catal.*, 1991, **70**, L1

14 M. Iwamoto, H. Yahiro, S. Shundo, Y. Yu-u and N. Mizuno, *Appl. Catal.*, 1991, **69**, L15

15 Y. Kintaichi, H. Hamada, M. Tabata, M. Sasaki and T. Ito, *Catal. Lett.*, 1990, **6**, 239

16 H. Hamada, Y. Kintaichi, M. Sasaki, T. Ito and M. Tabata, *Appl. Catal.*, 1990, **64**, L1

17 *Op. cit.* (Ref. 16), 1991, **75**, L1

18 W. Held, A. Konig, T. Richter and L. Ruppe, SAE Paper No. 900496, 1990

Rhodium-Iron Resistance Thermometer

For some twenty years the rhodium-iron resistance thermometer has been regarded as one of the most reliable for low temperature measurement, and in various forms has been used from millikelvin regions up to room temperature. Although it is known that the annealing treatment is one of the most important factors controlling the thermometric properties of such thermometers, only limited information is available about their stability when the rhodium-iron (mole fraction 0.5 per cent) is in the form of wire.

A recent communication from the National Research Laboratory of Metrology, Japan, reports on the effects of annealing on a new type of rhodium-iron thermometer, in which the 50 μm diameter wire is wound bifilarly around a cross-shaped frame machined from fused silica. (O. Tamura and H. Sakurai, "Rhodium-Iron Resistance Thermometer with Fused-Silica Coil Frame", *Cryogenics*, 1991, **31**, (10), 869–873). The use of fused silica enables the sensing element to be annealed at temperatures above 600°C. The four lead wires and the protective sheath are made of platinum. The influence of annealing temperatures between 700 and 900°C upon the resistance of the thermometer has been investigated, and a calibration method proposed for cryogenic use of the thermometers.

It is concluded that an annealing temperature of 800°C is required to remove the strain produced in the wire by coiling; thermometers annealed at or above this temperature have similar temperature-resistance characteristics and, after calibrating the deviation from a reference function at only three calibration points, can be used with an accuracy better than 0.5 mK over the range 4.2 to 25 K. Self-heating effects were found to be of a reasonable magnitude.