In the latter application platinum group metals, of use in many catalytic reactions of technological interest, could naturally play a leading role.

There are sound theoretical reasons to expect that the NEMCA effect is more pronounced (higher α values) on metals with high local density of states (LDOS) near the Fermi level, as is the case for most of the platinum group metals.

However there is already some experimental evidence supporting this idea. The LDOS at the Fermi level is 2.2 and 2.3 states/eV atom, for platinum and palladium, respectively, while it is only 0.27 states/eV atom for silver. In comparison the absolute value of α is 0.3–1.0 for platinum-catalysed reactions and 0.1–0.2 for reactions which are catalysed by silver.

Conclusions

Solid electrolytes can be used as ion donors or acceptors to control the work function of metal catalysts and to induce dramatic and reversible changes in catalytic activity and selectivity. The effect is very pronounced for platinum, but is not restricted to a particular metal or solid electrolyte. The use of NEMCA, that is of in situ electrochemical promotion of catalyst surfaces, allows for new areas of surface catalytic chemistry to be explored, and could lead to technological applications by influencing catalyst performance in desirable directions.

References

1 C. G. Vayenas, S. Bebelis and S. Ladas, *Nature*, 1990, **343**, (6259), 625

2 J. Pritchard, *Nature*, 1990, **343**, (6259), 592

3 C. G. Vayenas, S. Bebelis and S. Neophytides, *J. Phys. Chem.*, 1988, **92**, 5083

4 I. V. Yentekakis and C. G. Vayenas, *J. Catal.*, 1988, **111**, 170

5 C. G. Vayenas, S. Bebelis, S. Neophytides and I. V. Yentekakis, *Appl. Phys.*, 1989, **A49**, 95

6 S. Bebelis and C. G. Vayenas, *J. Catal.*, 1989, **118**, 125

7 S. Neophytides and C. G. Vayenas, *J. Catal.*, 1989, **118**, 147

8 H.-G. Lintz and C. G. Vayenas, *Angew. Chem.*, 1989, **101**, 725; *Int. Ed. Engl.*, 1989, **28**, 708

9 C. G. Vayenas, S. Bebelis and M. Despotopoulou, *J. Catal.*, 1990, submitted

10 C. G. Vayenas and S. Neophytides, *J. Catal.*, 1990, submitted

11 M. Boudart, *J. Am. Chem. Soc.*, 1952, **74**, 3556

12 C. G. Vayenas, *Solid State Ionics*, 1988, **28–30**, 1521

13 P. J. Feibelman and D. R. Hamann, *Surf. Sci.*, 1985, **149**, 48

14 L. Surnev, *Surf. Sci.*, 1981, **110**, 458

15 H. P. Bonzel, *Surf. Sci. Rep.*, 1987, **8**, 43

16 G. Binnig and H. Rohrer, *Surf. Sci.*, 1983, **126**, 236

Palladium Doped Semiconductor Alcohol Sensor

The detection and accurate measurement of the alcohol concentration in breath has been traditionally performed by a fuel cell, with the expired air being oxidised catalytically on a platinum electrode, and the small current generated being amplified (1).

Now Japanese researchers have produced a semiconductor detector which is capable of being used as a breathalyser, and which will selectively ignore other gases (2).

The basis of the detector is a porous alumina substrate, onto which a thick film (about 50 μm) of lanthanum oxide containing indium oxide and palladium was screen printed. Gold electrodes were attached and the whole was then calcined. Indium oxide was chosen as the semiconductor as previous attempts with tin(IV) oxide resulted in an unacceptably high increase in electrical resistance.

The addition of lanthanum oxide improved the sensitivity to ethanol vapour almost 7 fold, even though the electrical resistance and the response time also increased. The further addition of palladium was especially effective, dramatically increasing the sensitivity and shortening the 90% response time to about 35 seconds for 1000 ppm ethanol in air at 300°C.

The device has an "S" shaped response to alcohol gas concentrations between 0 and 1000 ppm at 300°C, being approximately linear from 0 to 100 ppm, and its selectivity to gases at 300°C, other than ethanol, is only modest.

References

1 *Platinum Metals Rev.*, 1974, **18**, (3), 91

2 J. Tamaki, T. Maekawa, S. Matsushima, N. Miura and N. Yamazoe, *Chem. Lett. Jpn.*, 1990, (3), 477