ferrocinium, and c) decasubstituted neutral metallocenes, $(C_5R_5)_2M$, where R = phenyl or benzyl and M = Sn(II) or Ge(II). Examples of each type were active in markedly inhibiting tumour growth and induced severe cytological and histological changes in the tumours treated, which suggested that the complexes interfere with nucleic acid metabolism. Reaction of the titanium complex resulted in $[Cp_2Ti]^+$ co-ordinated to purine nucleosides through both monodentate N7 and N7-O6 chelation. The vanadocene moiety appears to bind in a labile outer-sphere fashion to phosphate groups. Doses of Cp_2TiCl_2 are limited by liver toxicity.

Ruthenium and platinum compounds may be used to direct radiosensitising molecules to DNA, according to Professor Nicholas Farrell of the University of Vermont. This approach is particularly useful in radiotherapy applied to hypoxic or anoxic areas of tumours, where radiation is less effective. Studies on the radiation killing of cells indicate that metal complexes ligated with nitroimidazoles are more active than either the metal or ligand precursor molecules alone and so point a way to the design of new agents.

The ruthenium isotope, ^{97}Ru, has excellent radiophysical properties for use in diagnostic imaging agents. Its γ-ray is easily collimated by existing radioscintigraphic cameras and its 3-day half-life provides adequate time for synthesis and quality control. Dr. Suresh Srivastava of Brookhaven National Laboratory presented the first clinical studies of a liver-imaging agent using a complex with diisopropyl carbamoylmethyl iminodiacetate, which proved very effective in imaging the livers of neonates suspected of liver dysfunction. Radiolabelling studies also showed that some Ru(III) complexes can be bound to transferrin and carried to receptor sites on tumours. The metal ion is fixed inside the cell, possibly by a redox mechanism, while the transferrin is released.

The symposium discussions concerning the various approaches to ruthenium-containing anti-cancer drugs reflected the versatility of this element in synthesis, electron transfer, and even photochemistry. These properties, coupled with the affinity of ruthenium's intermediate oxidation states for imine nitrogens, facilitate DNA targeting for both chemotherapeutic and radiosensitising agents. Finally, the existence of isotopes with desirable properties for diagnostic imaging indicates that exploration of the medical applications of ruthenium is likely to produce useful pharmaceuticals.

Lean-Burn Oxygen Sensor Material

PLATINUM CATALYST IMPROVES RESPONSE TIME

Oxygen sensors are widely used as automobile engine control devices in order to obtain an optimised balance of exhaust emissions, fuel economy and vehicle drivability, and generally this is achieved by controlling the air to fuel ratio at the stoichiometric mix of 14.7:1. Now there is increasing interest in controlling the air to fuel ratio away from the stoichiometric point, in the lean-burn region, with the aim of increasing engine efficiency and decreasing nitrogen oxides emissions.

Lean-burn oxygen sensors are generally classified as either semiconducting or electrochemical pumping. The former are small, simple, low cost devices which are based upon the resistivity changes that take place in oxide semiconductors as the partial pressure of oxygen in the surrounding atmosphere varies.

A recent paper by C. Yu, Y. Shimizu and H. Arai of Kyushu University, Fukuoka, Japan, reports on their investigation of several species of magnesium-doped $SrTiO_3$ in the exhaust gas resulting from air-propane combustion containing water vapour ("Mg-Doped $SrTiO_3$ as a Lean-Burn Oxygen Sensor", *Sens. Actuators*, 1988, **14**, (4), 309–318). At temperatures between 600 and 800°C, the highest sensitivity to oxygen in the lean-burn region and the lowest sensitivity in the rich-burn region was shown by $SrTi_{0.6}Mg_{0.4}O_{3-\delta}$, and therefore it was considered to be a suitable material for a lean-burn oxygen sensor. However the response time was about 1.5 seconds, which is too long for use in an automobile engine system. When 1 weight per cent platinum was added as a catalyst the response time was reduced significantly and in addition the sensitivity was increased in the lean-burn region.