A number of areas are currently under investigation

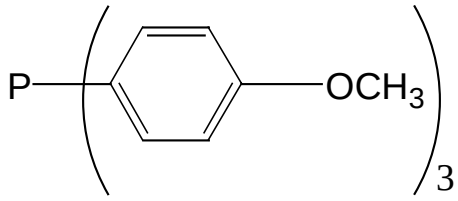
1. Electrospray mass spectrometry (ESMS)

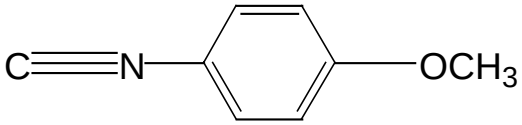
ESMS is a powerful, relatively recent technique for the characterisation of inorganic and organometallic substances, and we are particularly interested in developing the technique for the analysis of "difficult" materials. ESMS is being applied in conjunction with other international research groups, for example in the characterisation of rhenium-hydroxy and platinum-sulfide complexes with Professor Andy Hor and Dr. Yaw Kai Yan in Singapore.

Recent examples include:

- Development of **ionisation methods** for the analysis of a wide range neutral metal carbonyl compounds, such as $Ru_3(CO)_{12}$, which do not give ESMS spectra in the absence of such derivatisation.

- The development of **electrospray-friendly ligands**, which assist ion formation when incorporated into inorganic compounds. Some examples are shown below.





References:

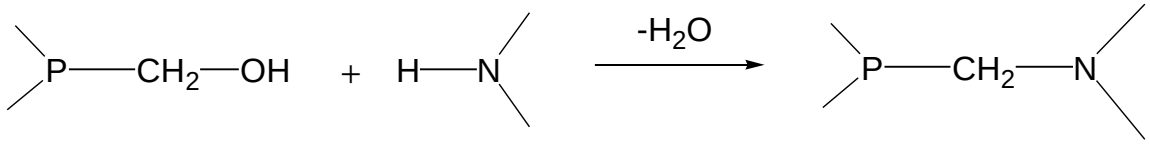
"Electrospray mass spectrometry of highly moisture-sensitive metal alkoxides", T. Løver, W. Henderson, G. A. Bowmaker, J. M. Seakins, and R. P. Cooney, *J. Mater. Chem.*, 1997, 1553-1558.

"Electrospray mass spectrometry of neutral metal carbonyl complexes", W. Henderson, J. S. McIndoe, B. K. Nicholson and P. J. Dyson, *J. Chem. Soc. Dalton Trans.*, 1998, 519-525.

Triphenylphosphine and -arsine analogues which facilitate the electrospray mass spectrometric analysis of neutral metal complexes, C. Decker, W. Henderson and B. K. Nicholson, *J. Chem. Soc., Dalton Trans.*, 1999, 3507-3513.

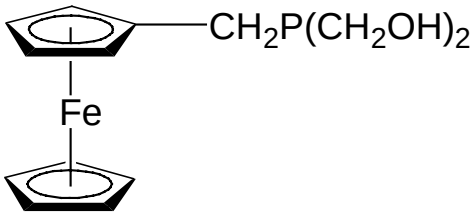
2. Chemistry of hydroxymethylphosphines

Hydroxymethylphosphines contain PCH_2OH groups, which can be easily synthesised, are commercially available in some cases, and show interesting and useful reactivity towards many reagents, particularly primary and secondary amines:



We have used this reactivity to **immobilise enzymes** onto solid supports which contain NH_2 groups, and are currently developing applications of this chemistry.

We are also investigating the chemistry of hydroxymethylphosphines derived from the organometallic redox-active molecule **ferrocene** (FcH), and have synthesised the phosphine $FcCH_2P(CH_2OH)_2$, shown below:



Removal of formaldehyde from this phosphine gives the primary phosphine $FcCH_2PH_2$, which is a rare example of a crystalline, completely air-stable primary alkylphosphines.

References

"(Ferrocenylmethyl)phosphine, $FcCH_2PH_2$ - an air-stable primary phosphine", N. J. Goodwin, W. Henderson, B. K. Nicholson, J. Fawcett and D. R. Russell, *J. Chem. Soc., Dalton Trans.*, 1999, 1785-1793.

"Water-soluble iridium and rhodium complexes with tris(hydroxymethyl)phosphine and their catalysis in biphasic hydrogenation and hydroformylation", A. Fukuoka, W. Kosugi, F. Morishita, M. Hirano, L. McCaffrey, W. Henderson and S. Komiya, *Chem. Commun.*, 1999, 489-490.

"Synthesis of ferrocenyl-phosphine modified silicon surfaces", R. D. Eagling, J. E. Bateman, N. J. Goodwin, W. Henderson, B. R. Horrocks and A. Houlton, *J. Chem. Soc., Dalton Trans.*, 1998, 1273-1275.

"Properties of a stable thermophilic β-glucosidase immobilised using tris(hydroxymethyl)phosphine, $P(CH_2OH)_3$, as a highly effective coupling agent", P.

R. Oswald, R. A. Evans, W. Henderson, C. J. Fee and R. M. Daniel, *Enzyme & Microbial Technology*, 1998, **23**, 14-19.

3. Chemistry of the platinum group metals

We are interested in the chemistry of these metals, for their fundamental properties, structures and chemistry, and also for the screening of new complexes for novel biological (e.g. anticancer) activity). There is particular interest in the following areas:

- Metallacyclic chemistry – complexes containing small (four- or five-membered) ring systems.

- Chemistry with amide and thiolate ligands. In recent years we have been studying the coordination chemistry of these metals with the thiosalicylate $(SC_6H_4CO_2)^{2-}$ ligand, a versatile hard/soft ligand, able to coordinate to metals in many different ways.

References

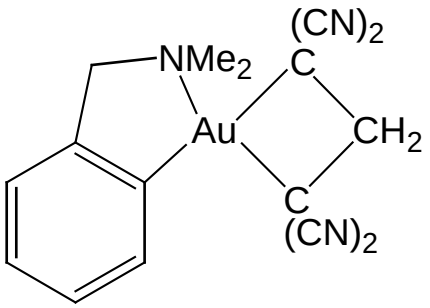
"Synthesis and biological activity of platinum(II) and palladium(II) thiosalicylate complexes with mixed ancillary donor ligands"**,** W. Henderson, L. J. McCaffrey and B. K. Nicholson, *J. Chem Soc., Dalton Trans*., 2000, 2753-2760.

"Platina- and palladalactam complexes derived from 2-benzoylacetanilide; syntheses and X-ray structure of [Pd{NPhC(O)CHC(O)Ph}(bipy)].CH_2Cl_2 ", W. Henderson, A. G. Oliver, C. E. F. Rickard and L. J. Baker, *Inorganica Chimica Acta* 1999, **292**, 260-265.

"Platinum(II) and palladium(II) saccharinate complexes", W. Henderson, B. K. Nicholson and L. J. McCaffrey, *Inorg. Chim. Acta*, 1998, **285(1)**, 145-148.

4. Gold chemistry

Gold(III) is isoelectronic with platinum(II), but in contrast the the vast amount of information known about platinum(II) complexes, much less is known about gold(III). We have been investigating similar chemistry to that of the platinum group metal complexes described in Section 3. above. One highlight is the synthesis of the first ever metallacyclobutane complex of gold, shown below.



References

"Organogold(III) metallacyclic chemistry. Part 4. Synthesis, characterisation, and biological activity of gold(III)-thiosalicylate and -salicylate complexes", M. B. Dinger and W. Henderson, *J. Organomet. Chem.*, 1998, **560**, 233-243.

"Synthesis and characterisation of the first auracyclobutane complex" M. B. Dinger and W. Henderson, *J. Organomet. Chem.*, 1999, **577**, 219-222.

5. Forensic chemistry

In conjunction with my colleagues Drs. Nick Kim and Tony Cartner, we are investigating the development of novel fingerprint reagents, particularly those derived from coordination and organometallic compounds.

Recent examples are the use of tin-porphyrin compounds and fluorescent europium(III) acetylacetonate derivatives.

Reference

"Appraisal of the porphyrin compound (TPP)Sn(OH)$_2$ as a latent fingerprint reagent", K. A. Murphy, A. M. Cartner, W. Henderson and N. D. Kim, *J. Forensic Identification*, 1999, **49**, 269-282.