

## Designing Metal Complexes to Generate Radical Cations of Peptides in the Gas Phase.

Chris Barlow, Sheena Wee, Richard A. J. O'Hair and W. David McFadyen

School of Chemistry, University of Melbourne, 3010, Victoria, Australia

### Introduction:

Siu and co workers recently discovered an unprecedented method of producing molecular radical cations of peptides in the gas-phase<sup>[1]</sup>. Electrospraying a mixture of a mixture of  $[\text{Cu}^{\text{II}}(\text{dien})(\text{NO}_3)_2]$  complex, (dien = diethylenetriamine) and a peptide (M) yields the  $[\text{Cu}^{\text{II}}(\text{dien})(\text{M})]^{2+}$  ion, whose CID (collision induced dissociation) spectra produces  $[\text{Cu}^{\text{I}}(\text{dien})]^+$  and  $\text{M}^+$ , the molecular radical cation of the peptide. Since Siu's  $[\text{Cu}^{\text{II}}(\text{dien})\text{M}]^{2+}$  system appears to be restricted to certain types of peptides, we have been interested in exploring new metal complexes with a view to broaden the applicability of the use of metal complexes to generate radical cations of peptides. This presentation examines both the roles of the metal as well as the ligand in the mechanism of radical generation.

### Methods and Instrumentation:

We use electrospray ionization (ESI) of mixtures of copper(II) complexes  $[\text{Cu}^{\text{II}}(\text{ligand})\text{X}]$  and peptides (M) to generate cations in which the peptides form the copper(II) complex –  $[\text{Cu}^{\text{II}}(\text{ligand})\text{M}]^{2+}$ . Using multi-stage mass spectrometry experiments in an ion trap (LCQ), these cations are subject to CID to examine their ability in generating peptide radical cations. Other systems studied include chromium, cobalt, iron and platinum metal complexes.

### Results:

We have surveyed a series of complexes of the form  $[\text{Cu}^{\text{II}}(\text{L}^2)(\text{M})]^{2+}$ , where ( $\text{L}^2 = 1,10$ -phenanthroline, 2,2'-bipyridine, 1,10-Phenanthroline-5,6-quinone, Dipyrrophenazine, 2,9-Dimethyl-4,7-Diphenyl-1,10-Phenanthroline, 3,4,7,8-Tetramethyl-1,10-phenanthroline, 5-Amino-1,10-Phenanthroline, 5-Nitro-1,10-Phenanthroline, and 4,7-Dihydroxy-1,10-Phenanthroline; M = the hexapeptide YGGFLR). It was found that a number of these complexes generate small amounts of radical, although they primarily fragmented via loss of protonated ligand to generate complementary  $[\text{L}^2+\text{H}^+]^+$  and  $[\text{Cu}^{\text{II}}(\text{M}-\text{H}^+)]^+$  ions or via loss of a p-quinomethide radical from the tyrosine side-chain to generate  $[\text{Cu}^{\text{II}}(\text{M}-\text{C}_7\text{H}_7\text{O})]^{2+}$ . In addition to this work, CID of the  $[\text{Cu}^{\text{II}}(\text{tren})(\text{M})]^{2+}$  ion (tren = traminotriethylamino) has been found to exclusively produce  $\text{M}^+$  and  $[\text{Cu}^{\text{II}}(\text{tren})]^{2+}$ . Other metal complexes give variable yields of  $\text{M}^+$ . Surprisingly, the  $\text{M}^+$  ions generated from the tren and Tetramethyl-phenanthroline complexes, yield different CID spectra suggesting that the presence of isomeric peptide radical actions.

[1] I. K. Chu, C. F. Rodriguez, T. C. Lau, A. C. Hopkinson, K. W. M. Siu, *J. Phys. Chem. B*, **2000**, *104*, 3393-3397.