

School of Chemistry

Aims and Objectives: Session 2023-2024

Module CH3514: Physical Inorganic Chemistry

Course Title: Physical Chemistry and Bonding of Transition Metals

Duration: 7 hours

Lecturer: Dr J. A. McNulty

Aims: A continuation of the chemistry of the 3d transition metals with particular focus on the thermodynamics, bonding and kinetics of reactions.

Objectives:

1. A summary of how d-orbitals affect the properties of the transition metals.
2. To understand metal ion-ligand complexation equilibria; stepwise formation and overall stability constants. Relationship of β_{ML} to K_{ML} and ΔG°_{ML} .
3. To understand the trends in β_{ML} across the period Sc – Zn and the Irving Williams maximum at Cu^{2+} due to Jahn-Teller effect at d^9 .
4. To understand how molecular orbital theory can be used to explain the properties of metal-ligand complexes.
5. To understand the origins of the chelate effect – the increase in β_{ML} with chelate ligands. To appreciate and rationalise the entropic and enthalpic factors involved – trends across the period and the link to LFSE. To understand the mode of action of chelation therapy.
6. To understand quantification of oxidation and reduction potentials and the illustration of these using Latimer and Frost-Ebsworth diagrams.
7. To appreciate that thermodynamic stability and kinetic lability are independent phenomena – not necessarily correlated. Equilibrium can be rapidly obtained irrespective of the size of K_{ML} .
8. To appreciate the range of labilities on 3d aqua metal ions and the correlation with LFSE. Definition of the terms inert and labile. Correlation of inertness with high LFAE – linked to LFSE.