Abstract

This thesis is divided up into four chapters and four publications, which all deal with the same topic: The oxidation chemistry of metal complexes of non-heme ligands. Each chapter approaches this topic from a slightly different point of view; Some parts are focused on iron chemistry and some parts on chromium chemistry. Some parts deals with the reactivity with chemical agents, while others are focused on electrochemical reactions with electricity as the driving force. However, most of the chemistry described in this thesis is centred around one particular ligand: *tpena*. This is a unique peptide-like molecule, which is able to recreate the coordination environment found in the active sites of non-heme metal enzymes. *tpena* provides five nitrogen donors and one carboxylate donor, to which metal ions can coordinate. The presence of a carboxylic acid changes many properties of coordinated iron ions in a subtle way; Instead of having iron(II) as the stable oxidation state, iron(III) states are now stable, and instead of not being soluble in water; excellent water-solubility is the case.

A literature review of the oxidation chemistry of non-heme iron complexes is described in the attached book chapter (*publication **A3***).

Chapter 1 and *publication **A1***, describes the oxidation chemistry of chromium complexes of *tpena* and compares it to that of the related iron complexes in organic solvents. The generation and reactivity of several oxidized chromium complexes are described, together with their reactivity in different reactions. The iron chemistry of *tpena* and its reactivity in selective oxidations in organic solvent are presented in *publication **A2***. The related *un*selective reactivity in water under electrochemical control is explored in *manuscript **A4***, with focus on *iron-tpena* as a homogeneous electrocatalyst for water remediation.

The last three chapters (***Chapter 2, 3** and **4***) is about carbon chemistry and is part of an interdisciplinary project on attaching molecular iron complexes onto the surface of graphene and graphite. ***Chapter 2*** deals with the covalent attachment of a molecular phenolate diiron complex onto graphene. ***Chapter 3*** explores the non-covalent incorporation of a commercially available *iron-TAML* complex onto graphite, and the use of this hybrid material as a heterogeneous electrochemical catalyst for the removal of color from contaminated waters. The last chapter, ***chapter 4*** deals with the non-covalent attachment of three other non-heme iron complexes onto the surface of graphite, with *iron-tpena* being one of the complexes investigated.