

## MASTER'S THESIS

### Synthesis and characterization of Prussian red derived microparticles for the heterogeneous photo-fenton oxidation of azo-type textile dyes as pollutants

Lai, Joshua

*Date of Award:*  
2020

[Link to publication](#)

#### General rights

Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

## Abstract

Inorganic colloidal synthesis, without a doubt, lies at the foundation of many contemporary areas of nanoscience and nanotechnology. At the advent of the 21<sup>st</sup> century, much progress has been made in the size, shape / morphological control and surface engineering of metal oxides resulting in a diverse library of macroscopic crystal architectures with well-defined surface properties. In this thesis, we start by introducing the self-assembly of the iron(oxy-, hydro-)xide while briefly reviewing some fundamental concepts of solid-state chemistry. Specific information on the family of iron oxide and iron(oxy-, hydro-)xide, as relevant to crystalline phase control, has been highlighted to direct our discussion of the synthesis of diverse crystal morphologies. Furthermore, we briefly underline and discuss the kinetic and thermodynamic control of colloidal crystal morphologies through reasonably established knowledge of anisotropic growth rates in the perspective of iron oxides' facets or crystalline planes. Lastly, we review the state-of-the-art wet chemical synthetic approaches, while using different iron(oxy-, hydro-)xide crystals as examples, for the purpose of explaining our synthetic work of choice.

The main work of this thesis is entirely focused on the “facile synthesis and fine morphological tuning of branched hematite ( $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>) crystals for photodegradation of azo-type dyes”. We would discuss the crucial parameters for fine morphological tuning in the context of controlling the anisotropic growth rates of branched  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> crystals instead of phase transformation. In our work, we have significantly improved the synthesis of dendritic “*feather-like*” and “*starfish-like*” for their size reduced variants for use in photocatalysis.

# Table of Contents

<b>Declaration</b> .....	i
<b>Abstract</b> .....	ii
<b>Acknowledgement</b> .....	iii
<b>Table of Content</b> .....	iv
<b>List of Tables &amp; Figures</b> .....	v
<b>Chapter 1: Introduction</b> .....	1
1.1 Background of Crystal Structure .....	1
1.2 Morphological Control of Crystals.....	7
1.3 Wet Chemical Synthetic Methods .....	10
1.4 Chemistry of Fenton Oxidation.....	11
1.5 Expected Findings of Study .....	13
1.6 Outline of the Thesis.....	13
<b>Chapter 2: Facile Synthesis &amp; Fine Morphological Tuning of Branched Hematite (<math>\alpha</math>-Fe<sub>2</sub>O<sub>3</sub>) Crystals for Photodegradation of Azo-Type Dyes</b> .....	15
2.1 Introduction .....	15
2.2 Results & Discussion.....	16
2.3 Experimental Procedure.....	54
2.4 Summary & Future Work.....	59
<b>List of References</b> .....	60
<b>Curriculum Vitae</b> .....	65