Use of Fourier Transform Infrared Spectroscopy to Examine the Fe(II)-Catalyzed Transformation of Ferrihydrite

Wei Xiao, Adele M. Jones, Richard N. Collins, Mark W. Bligh, T. David Waite

www.elsevier.com/locate/talanta

PII: S0039-9140(17)30731-2
DOI: http://dx.doi.org/10.1016/j.talanta.2017.07.018
Reference: TAL17717

To appear in: *Talanta*

Received date: 14 May 2017
Revised date: 3 July 2017
Accepted date: 4 July 2017

Cite this article as: Wei Xiao, Adele M. Jones, Richard N. Collins, Mark W. Bligh and T. David Waite, Use of Fourier Transform Infrared Spectroscopy to Examine the Fe(II)-Catalyzed Transformation of Ferrihydrite, *Talanta* http://dx.doi.org/10.1016/j.talanta.2017.07.018

Use of Fourier Transform Infrared Spectroscopy to Examine the Fe(II)-Catalyzed Transformation of Ferrihydrite

Wei Xiao, Adele M Jones, Richard N Collins, Mark W Bligh, T David Waite*

UNSW Water Research Centre, School of Civil and Environmental Engineering, UNSW Australia, Sydney, NSW 2052, Australia

*Corresponding author. Tel.: +61 2 9385 5060; fax: +61 2 9385 6139. d.waite@unsw.edu.au

Abstract

The Fe(II)-catalyzed transformation of the poorly crystalline Fe(III) oxyhydroxide mineral, ferrihydrite (Fh), to more crystalline Fe(III) mineral species such as magnetite, goethite, and lepidocrocite has been quantitatively evaluated under various conditions using X-ray adsorption spectroscopy (XAS) and Fourier transform infra-red (FTIR) spectroscopy. Using the peak height of signature FTIR peaks of sub-micron sized lepidocrocite and goethite references minerals, the FTIR results were comparable to the XAS results within experimental error. This was independent of whether the Fe(II)-catalyzed transformation was initiated by the Fe(III)-reducing bacterium *Shewanella oneidensis* MR-1 or by added ferrous ammonium sulfate in the presence or absence of lactate. Whilst the use of FTIR has not been previously employed to follow this transformation process, it has advantages relative to XAS including a lower sample requirement (approximately 30-fold lower), greater accessibility and greater safety of operation. Whilst problems with quantifying magnetite in the presence of lepidocrocite were identified in this study using reference Fe(III) oxyhydroxide suspensions, large amounts of magnetite were not produced during transformation under the conditions employed in this study. Reference spectra of lath-like nano-goethite particles (with dimensions of approx. 10 x 50 nm) also resulted in higher IR absorbance and a slight red-shift in signature peak positions relative to sub-micron sized goethite particles with this shift