Metal cation substitution in lepidocrocite (γ-FeOOH)

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Introduction

Lepidocrocite (-FeOOH) is one of several metastable precursor phases to the more stable goethite (-FeOOH) and forms specifically from the oxidation of ferrous (Fe^{2+}) ions in solution in the absence of HCO_3^- ions (pH < 6.35) [1]. Despite the abundance of literature on metal cation substitution in iron oxides, the incorporation of trace and heavy metals into lepidocrocite has to date only been sparingly addressed [2, 3]. In this work, we are reporting on the extent of substitution of Cr-, Mn^{II}-, Cu-, Zn-, Cd- and Pb-for-Fe in lepidocrocite and their effect on the structural parameters.

Results

Three nominal mole % levels (2.5, 5.0 and 10) were investigated for each metal at pH 6 and revealed that the order of incorporation decreased from Zn < Cr << Cd < Mn ~ Cu < Pb. Synchrotron-based XRD anlyses showed goethite forming in all metal substituted samples with the exception of Cd and Pb. Chromium induced the formation of a diasporic phase, whose diffraction peaks were shifted from those of pure goethite suggesting changes in the unit cell dimensions as a result of Cr incorporation. Increasingly poorly crystalline lepidocrocite formed as a result of increasing Zn content. Only traces of goethite formed in Zn substituted samples.

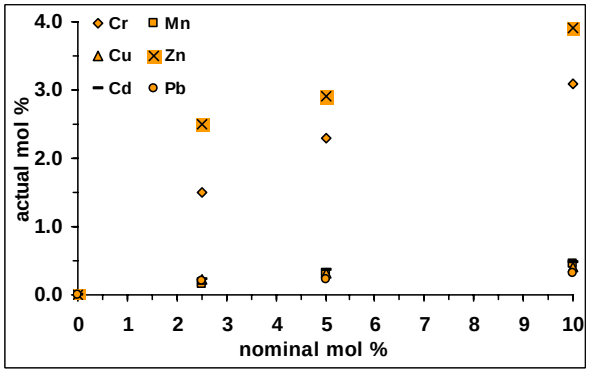

Figure 1: Actual mole % substitution as a function of (initial) nominal mole % applied.

References

[1]. Cornell, R.M. and U. Schwertamann, 1996, Weinheim: VCH Verlagsgesellschaft mbH.

[2]. de Grave, E., et al., Clays Clay Min, 1996. **44**(2): p. 214-219.

[3]. de Grave, E., et al., Clay Min., 2002. **37**(4): p. 591-606.