

Spectroscopic Study for a Cr-adsorbed Montmorillonite

XIAOKE ZHANG¹ YUANFENG CAI² LIJUAN BAI³

¹ School of Earth Sciences and Engineering, Nanjing 210046, P.R. China. Email: 932457258@qq.com

² State Key Laboratory of Metal Deposits Research, School of Earth Sciences and Engineering, 163 Xianlin Dadao, Nanjing 210046, P.R. China. Email: caiyf@nju.edu.cn

³ School of Earth Sciences and Engineering, Nanjing 210046, P.R. China. Email: 905143541@qq.com

Purified montmorillonites with trace amounts of quartz were subjected to different concentrations of $\text{Cr}_2(\text{SO}_4)_3$ solutions for one week to allow cation exchange. The Cr-bearing montmorillonites were verified and tested using powder X-ray diffractometry (XRD), X-ray fluorescence spectrometry (XRF), electron spin resonance (ESR) spectrometry and Fourier transformation infrared (FTIR) spectroscopy to explore the occupation sites of the chromium. ESR spectra recorded before, after the chromium exchange and heated show clear differences: a strong and broad resonance with two shoulders at the lower magnetic field side was present, its intensity increased with the concentration of added chromium, but decreased with the rising of temperature. The signals introduced by the chromium, for example at $g = 1.975$ and 2.510 etc. in the second derivative spectrum, suggested that the chromium had several occupational sites. The main resonance centred at $g = 1.975$ indicated that the majority of Cr^{3+} occupied the interlayer region as $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$. This resonance decreased and shifted to $g = 1.969$ as it was heated at $300\text{ }^\circ\text{C}$, formed one weak peak centred at $g = 1.966$ as the temperature higher than $500\text{ }^\circ\text{C}$. The substitution of Ca^{2+} by Cr^{3+} also greatly affected the vibration of the hydrogens associate to water in FTIR. Furthermore, the presence of two diffraction lines in the XRD results (specifically those with d -values of 1.52 and 1.27 nm) suggested the presence of two types of montmorillonite with different hydration cations, as $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cr}(\text{H}_2\text{O})_3\text{O}_3]^{3+}$, as exposed to 0.2 M $\text{Cr}_2(\text{SO}_4)_3$. This also suggested that the species of hydration cation was constrained by the concentration of the chromium solution.

Acknowledgements This study was supported by MOST 973 Project (2012CB822001), NSFC Project (41272055) and grant (G1210284013).