

²⁷Al and ²⁹Si MAS NMR study on adsorption of monosilicic acids to aluminum combined on the surface of chelate resin, their polymerization and deposition of silica: A model reaction for biodeposition of silica

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In order to elucidate the mechanism of biodeposition of silica that aluminum participates, adsorption behavior of monosilicic acid to aluminum combined to the chelate resin, Chelex 100 (Al type, the amount of Al adsorbed: 0.38 mmol/g) was examined. Since the functional group is iminodiacetate, Chelex 100 was selected as a model compound of the surface of microbe. No silicic acid was adsorbed to the original Chelex 100 (Na type), whereas monosilicic acids were adsorbed to the Al type Chelex 100. The aluminum and silicic acid on the Chelex 100 were characterized by ²⁷Al and ²⁹Si MAS NMR and SEM-EDX. The results indicate that monosilicic acids are chemically adsorbed to the resin-Al-OH site by the formation of the resin-Al-O-Si(OH)₃ bond based on the downfield shift of ²⁷Al NMR peak. The polymerization of monosilicic acids combined proceeded with increasing silicic acid concentration. Judging from the SEM image for the surface of Al type Chelex 100 particles, the resin-Al-O-Si(OH)₃ site acts as a template for the successive adsorption site of monosilicic acids to form silica sheet. In conclusion, aluminum combined on the surface of microbe plays a key role for beginning of the biodeposition of silica.

Sorption of U(VI) onto K-birnessite

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A batch sorption experiment was conducted to investigate the U(VI) sorption properties of a synthesized manganese oxide, K-birnessite with a two-dimensional layered structure. The K-birnessite was synthesized by a reducing method [1]. The physico-chemical properties of the K-birnessite were characterized by using various methods such as BET (38.30 m²/g), FT-IR, SEM, TGA (thermogravimetric analysis), X-ray spectroscopy, and potentiometric titration.

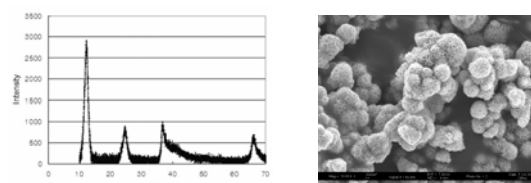


Figure 1: The results XRD and SEM measurements for the synthesized K-birnessite.

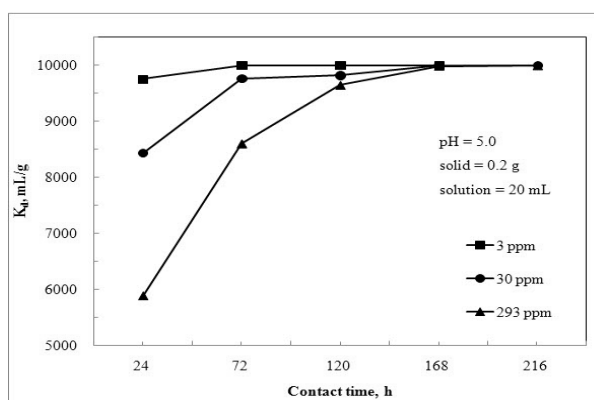


Figure 2: Result of the U(VI) sorption onto the K-birnessite as a function of the contact time and the initial concentration.

It is conceivable that U(VI) is taken up by both an ion exchange and a surface complexation [2]. The distribution coefficient (K_d) of the U(VI) sorbed onto the K-birnessite showed high K_d values regardless of the contact time and the initial concentrations of an uranium although the K_d values increased with an increasing contact time.

The high K_d values of U(VI) reveal that K-birnessite can be used as a getter to remove U(VI) even at a high loading concentration of 300 ppm and a low pH of 5. Besides, the result implies that a U(VI) migration can be retarded when U(VI) migrates through a geological medium containing K-birnessite as a constituent mineral.

[1] Villalobos *et al.* (2003) *Geochim. Cosmochim. Acta* **67**, 2649. [2] Al-Attar & Dyer (2002) *J. Mat. Chem.* **12**, 1381.