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Progression of Gibbsite Nano-crystals

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Nano-crystals attracted much attention because of their novel properties originating from their small size. Gibbsite (α-$Al(OH)_3$, monoclinic, P21/n) structure consists of double layers of closely packed OH groups with Al atoms occupying two thirds of the octahedral interstices within the layers. The aim of the work is to synthesis and characterization of gibbsite nano-crystals formation under different equilibration time scales. Gibbsite nano-crystals were prepared by titration of $AlCl_3$ with NaOH followed by dialyzing against double-distilled water. Synthesized gibbsite particles were characterized by X-Ray Diffraction (XRD) and Fourier Transformation Infra-Red spectroscopy (FTIR) and Transmission Electron Microscopy (TEM). The gibbsite crystals are dominantly hexagonal in shape and they were around 90 nm in diameter. The initial product of $Al(OH)_3$ is amorphous and as dialyzing proceeds it gradually transformed into crystalline structure. Diffraction patterns after 20, 30 and 60 days of dialysis showed peaks characteristic of typical gibbsite. A major peak at 4.86 Å is developed at 2θ of 18.24° that corresponds to the basal planes. Thus, XRD patterns suggest that 10 days of dialysis as a transition periods of aluminum hydroxide to gibbsite crystals formation. FTIR spectrum of the initial product after a day of synthesis shows broad bands at around 3443, 1634, 1025 and 581 cm^{-1}. However, the structural OH groups of the crystals appeared after the 10 days of dialysis. The FTIR spectrum showed typical bands for gibbsite at 3621 cm^{-1}, 3526 cm^{-1} and 3461 cm^{-1} for ~OH stretching region and 1024 cm^{-1} and 974 cm^{-1} for OH bending vibrations. Interestingly, aged sample at pH 9 shows somewhat different spectrum. Wavenumbers at 3650, 3547, 3421 and 1020, 980 cm^{-1} are corresponding to OH stretching and bending vibration of bayerite respectively. Thus pH of the suspension plays a critical role in selection of aluminum hydroxide morphology.

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