

Microscopy of Nanoobjects

Structural and morphological features of disperse alumina synthesized using aluminum nitrate nonahydrate

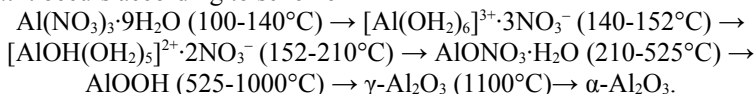
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Transformation of $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ (upon heating in the range of 20-1200°C) into blends of amorphous and crystalline boehmite (210-525°C), amorphous alumina and crystalline $-\text{Al}_2\text{O}_3$ (850°C), and crystalline $-\text{Al}_2\text{O}_3$ (1100°C) was analyzed using XRD, HRTEM, IR spectroscopy, thermogravimetry and low-temperature nitrogen adsorption. Investigations of calcination effects on transformations of aluminum nitrate nonahydrate into boehmite, $-\text{Al}_2\text{O}_3$ and $-\text{Al}_2\text{O}_3$ show that it occurs according to scheme



Amorphous and crystalline phases of boehmite formed at $T > 210^\circ\text{C}$ represent nanoparticles of 6-10 nm in size strongly aggregated since $S_{\text{BET}} = 66 \text{ m}^2/\text{g}$ is smaller than it should be for unbound nanoparticles of the same sizes. In the amorphous phase, chains with $-\text{AlOH} - \text{O} - \text{AlOH} -$ have the length of 1-5 nm. Heating at 350-525°C results in the formation of mesoporous aluminum hydroxide with decreasing size (2.5-5.0 nm) of nanoparticles. However, tight joining of these nanoglobules strongly reduces the specific surface area to $180 \text{ m}^2/\text{g}$ instead of $350 \text{ m}^2/\text{g}$ for individual spherical nanoparticles of similar sizes. Subsequent heating at 850°C leads to enhanced binding of $\gamma\text{-Al}_2\text{O}_3$ nanoparticles in strongly aggregated structures and S_{BET} drops down to $77 \text{ m}^2/\text{g}$. Corundum particles formed at 1100°C are characterized by additionally increased joining in the aggregates because the value of S_{BET} is minimal ($14 \text{ m}^2/\text{g}$).