Catalysis of molecular alumina clusters in an organic solvent

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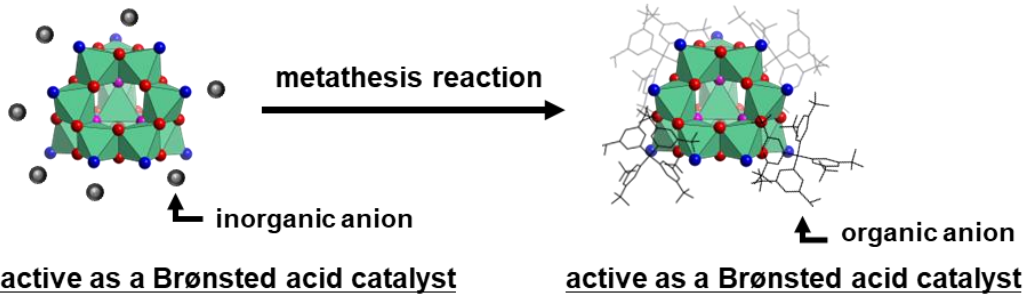
Aluminum oxide (alumina) is widely used as a catalyst because of the thermodynamically stable structure and high specific surface area.[1)] Bulk alumina can be utilized as a Lewis acid catalyst, while they are inactive as a Brønsted acid catalyst.[2)]

Molecular alumina clusters are cationic aluminum oxo-hydroxo clusters and possess the similar surface structures to those of alumina. In contrast to the bulk alumina, the coordinated to the ends of the 6-coordinated Al sites in molecular alumina clusters to give proton-rich structures, including $[Al_8(OH)_{14}(H_2O)_{18}]^{10+}$, $[Al_{13}O_4(OH)_{24}(H_2O)]^{7+}$ and $[Al_2O_8Al_{28}(OH)_{56}(H_2O)_{26}]^{18+}$, and these protons are thought to act as a Brønsted acid.[3)] For example, ionic crystals of $[\delta\text{-}Al_{13}O_4(OH)_{24}(H_2O)_{12}]^{7+}$ and $[\alpha\text{-}CoW_{12}O_{40}]^{6-}$ have been reported to act as Brønsted acid catalysts.[4)]

However, molecular aluminum clusters alone have not been studied as catalysts presumably because they tend to be gelatinized or isomerized in aqueous media. Therefore, we focused on stable $[\varepsilon\text{-}Al_{13}O_4(OH)_{24}(H_2O)_{12}]^{7+}$ (**Al_{13}**) and envisaged that development of an organic solvent-soluble **Al_{13}** could achieve unique homogeneous catalyst in organic media. In this study, we report on synthesis and catalysis of organic solvent-soluble **Al_{13}** which was synthesized by metathesis reactions.



1) I. Bezverkhy P. Afanasiev, C. Geantet, M. Lacroix, *J. Catal.* **2001**, *204*, 495–497.
2) R. M. Pearson, *J. Catal.* **1977**, *46*, 279–288.
3) L. Bergaoui, I. Mrad, J. F. Lambert, A. Ghorbel, *J. Phys. Chem. B* **1999**, *103*, 2897–2902.
4) W. Zhou, N. Ogiwara, Z. Weng, N. Tamai, C. Zhao, L. K. Yan, S. Uchida, *Chem. Commun.,* **2021**, *57*, 8893–8896.