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# Frustrated Lewis pairs on pentacoordinated Al<sup>3+</sup>-enriched Al<sub>2</sub>O<sub>3</sub> promote heterolytic hydrogen activation and hydrogenation

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### Abstract

As an emerging class of metal-free catalysts, frustrated Lewis pairs (FLPs) catalysts have been greatly constructed and applied in many fields. Homogeneous FLPs have witnessed significant development, while limited heterogeneous FLPs catalysts are available. Herein, we report that heterogeneous FLPs on pentacoordinated Al<sup>3+</sup>-enriched Al<sub>2</sub>O<sub>3</sub> readily promote the heterolytic activation of H<sub>2</sub> and thus hydrogenation catalysis. The defect-rich Al<sub>2</sub>O<sub>3</sub> was prepared by simple calcination of a carboxylate-containing Al precursor. Combinatorial studies confirmed the presence of rich FLPs on the surface of the defective Al<sub>2</sub>O<sub>3</sub>. In contrast to conventional alumina (gamma-Al<sub>2</sub>O<sub>3</sub>), the FLP-containing Al<sub>2</sub>O<sub>3</sub> can activate H<sub>2</sub> in the absence of any transition metal species. More importantly, H<sub>2</sub> was activated by surface FLPs in a heterolytic pathway, leading to the hydrogenation of styrene in a stepwise process. This work paves the way for the exploration of more underlying heterogeneous FLPs catalysts and further understanding of accurate active sites and catalytic mechanisms of heterogeneous FLPs at the molecular level.

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