Aluminum-mediated Base-free Catalysis for Transfer Hydrogenation

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ABSTRACT

Researchers at the University of California, Davis have developed an aluminum catalyst that enables fast, base-free transfer hydrogenation of aldehydes and ketones using isopropanol as a hydrogen source.

FULL DESCRIPTION

This technology provides an aluminum (Al) catalyst designed to perform transfer hydrogenation without requiring a base, using isopropanol (iPrOH) as the hydrogen source. The catalyst promotes chemoselective and rapid reduction of unsaturated substrates such as aldehydes and ketones. Aluminum, as an earth-abundant and cost-effective metal, is utilized with a tailored ligand framework to overcome existing challenges related to substrate compatibility, waste generation, and high catalyst load requirements common in traditional methods. This catalyst offers a wide substrate scope, enhanced sustainability, and compatibility with base-sensitive functional groups.

APPLICATIONS

- Pharmaceutical synthesis requiring chemoselective and sustainable reduction steps.
- Fine chemical production employing transfer hydrogenation under green chemistry principles.
- Commodity chemical manufacturing seeking cost-effective and environmentally friendly catalyst alternatives.
- Asymmetric synthesis development for chiral alcohol intermediates.
- Academic and industrial research focused on sustainable catalysis and main-group element catalysis.

FEATURES/BENEFITS

- Base-free transfer hydrogenation eliminates the need for stoichiometric bases, reducing waste and improving substrate compatibility.
- Utilizes abundant and affordable aluminum instead of precious metals.
- Catalyst design supports chemoselective and fast reduction of aldehydes and ketones.
- Operates efficiently with isopropanol as the hydrogen donor, leveraging its availability and favorable properties.
- Compatible with base-sensitive functional groups and avoids issues like self-aldol condensation.
- Potentially tunable for asymmetric transformations via ligand modification.

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OTHER INFORMATION

KEYWORDS

aldehyde reduction, aluminum catalyst, base-free transfer hydrogenation, chemoselectivity, green chemistry, isopropanol hydrogen source, ketone hydrogenation, main-group catalysis, sustainable catalysis, transfer hydrogenation

CATEGORIZED AS

- **Materials & Chemicals**
  - Chemicals

RELATED CASES

- Eliminates base requirements, avoiding side reactions such as substrate deprotonation and self-condensation.
- Reduces chemical waste by limiting the use of stoichiometric bases.
- Improves substrate scope to include aldehydes and other sensitive functional groups.
- Addresses cost and scarcity issues by replacing precious metal catalysts with aluminum.
- Mitigates high catalyst loading issues faced by traditional aluminum alkoxide catalysts.

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PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Group 13 Metals as Anolytes in Non-Aqueous, Redox Flow Batteries
- Organoaluminum Flow Battery Analytes
- Electrolyte Formulations for Non-Aqueous Flow Batteries

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