Improving the Catalytic Activity of Ruthenium in the Transfer Hydrogenation of Simple Ketones Using a Novel Diphenanthroline Amine Ligand

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Transfer hydrogenation of ketones via the dehydrogenation of alcohol is a highly valued reaction, as it allows for the mass production of compounds with pharmaceutical and industrial derivatives. However, these reactions are energy consuming and therefore the synthesis of optimal catalysts allowing for mild conditions, high selectivity and continuous use flow is an incessant effort. The purpose of this research is to synthesize a novel diphenanthroline amine ligand and test the organometallic catalytic activity in the transfer hydrogenation of ketones. The transition-metal portion is the reaction-center for ß-hydride elimination, whilst the dearomatization of the ligand allows for cooperative deprotonation of i-propanol, the hydrogen donor, and in return yields more energy-efficient reactions. An aromatic complex (phenanthroline-amine ligand) was prepared via coupling amizophenanthroline and chlorophenanthroline. It was then exposed to a transition-metal-halide (ruthenium chloride) and subjected to deprotonating conditions via the addition of a strong base, potassium tertbutoxide (KOtBu), to be tested as a transfer hydrogenation reaction catalyst. Deprotonation is favored as it dearomatizes the complex and optimizes catalytic activity in ketone-hydrogenation. The catalyst was tested on the transfer hydrogenation of cyclohexanone using isopropanol at 82°C for 12 hours with a loading of 1.0 mol%, from which a full conversion was achieved as noted via GC-MS analysis. It was discovered that the dearomatization of the ligand allows for maximized conversion with minimal catalyst loading. This research could lead to a catalyst that is less energy consuming and less expensive, while being environmentally friendly in several important industrial applications.

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