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High active Ru NPs immobilized on ionic polyamide as efficient catalyst for selective preparation of primary amines by reductive amination of carbonyl compounds

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PURPOSE OF THE ABSTRACT

Primary amines are valuable fine and bulk chemicals, which have wide-stretched applications in many fields related to our daily life, such as dyes, plastics, rubber, herbicides, pharmaceuticals, etc.[1] Until now, several approaches have been investigated for preparing primary amines, mainly including hydroamination of olefins, N-alkylation of alcohols and reductive amination of aldehydes/ketones. Among them, direct reductive amination (DRA), involving the utilization of ammonia (NH3) and hydrogen (H2), constitutes a begin and economic methodology and turns out to be an important goal of chemical research. Nevertheless, the efficient and versatile catalytic system targeting selective synthesis of primary amines via DRA process is still limited.[2,3] Therefore, the development of more active and selective catalysts towards effective utilization of NH3, especially for its insertion in a broad range of aldehydes/ketones, is highly desired.

Herein, we constructed a highly active ionic polyamide supported Ru nanoparticles (Ru@iTP) catalyst for the selective synthesis of various primary amines through the reductive amination of carbonyl compounds respectively using NH3 and H2 as the nitrogen and hydrogen resources (Figure 1). Thanks to the synergistic effect of the amide groups and ionic moieties in the support, ultra-fine and highly dispersed Ru nanoparticles (NPs) with an average size of ~2 nm could be facilely achieved. Detailed studies indicated that the electronic metal-support interaction contributed to the suitable electron density of Ru0 species, which could balance the activation of H2 for the hydrogenation steps and the desorption of intermediates (imines and Schiff bases), giving a promise of the high activity and selectivity. Meanwhile, Ru@iTP could be recycled at least 7 times without a decline of the catalytic activity and product selectivity.

FIGURES

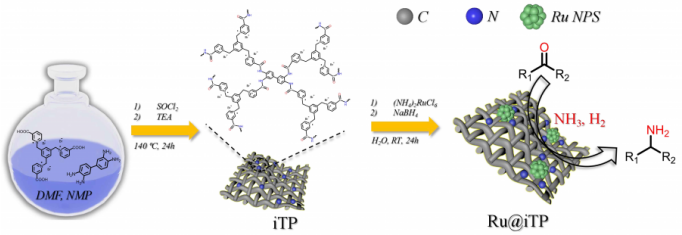

FIGURE 1

Figure 1

Schematic illustration of the Ru@iTP preparation and its promoted reductive amination of carbonyl compounds respectively using NH3 and H2 as the nitrogen and hydrogen resources.

FIGURE 2

KEYWORDS

heterogeneous catalysis | reductive amination

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