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Hydroisomerization of 1-Octene on Rhodium Nanoparticles Supported on Silicate Intercalated Magnesium-Aluminium Hydrotalcite

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Uniformly dispersed Rh nanoparticles on silicate intercalated magnesium-aluminium hydrotalcite were prepared for the first time by an incipient wetness method. FT-IR and powder XRD studies confirmed the presence of a layered structure even after Rh loading. Uniform distribution of Rh nanoparticles on HT materials was confirmed by HR-TEM. The resultant Rh nanoparticle supported HT materials showed good catalytic activity for hydroisomerization of 1-octene.

Keywords: Rhodium Nanoparticles, Hydrotalcite, Hydroisomerization of 1-Octene, Catalytic Isomerization, Layered Materials.

1. INTRODUCTION

In recent decades, transition metal nanoparticles have been extensively used in various applications, such as electronic circuits, magnetic materials, optoelectronics, medicine and catalysis.[1–4] In particular, metal nanoparticles in heterogeneous catalysis have been extensively used for various processes, including reforming, hydrogenation, hydrocracking, hydroformylation, carbonylation, Hydroisomerization and aromatization.[3–8] The controlled synthesis of metal nanoparticles with uniform size, composition and morphology is of crucial importance in order to tune their catalytic activities and selectivities.[9, 10] Nanoparticle-supported catalysts are widely recognized as a mainstay of industrial catalysis and are used in the manufacturing of fine and petrochemical products.[11] Recently a novel concept is developed in the field of nanotechnology it called as nanoarchitectonics which deals with creation of reliable nanomaterials by well organizing nanostructures.[12] Nanoarchitectonics has wide spread into various fields like nanostructured materials, supramolecular assemblies, hybrid materials, energy and environmental applications.[13, 14] Hydroisomerization of alkenes/alkanes is a fundamental organic transformation in petrochemical industries and is essential for achieving higher octane numbers for gasoline.[15] Lighter branched hydrocarbons (C_5–C_8) have higher octane numbers than their corresponding linear alkanes/alkenes and are consequently valuable additives to the gasoline pool.[16, 17] Zeolites and zeolite-like molecular sieves are used as heterogeneous catalysts for such transformations.[16–19] Hydrotalcite (HT, $[M(II)_{(1-x)}M(III)_x(OH)_2]^{x+} \cdot [A^{n-}]_{x/n} \cdot mH_2O$) based materials as anionic clays show great potential as supports and catalysts owing to their ability to form a wide range of tailor made materials by varying the framework cations. The introduction of various di- and trivalent metal ions favors several organic transformations, such as oxidation, reduction and isomerization. It is of interest to utilize the physicochemical properties of HT materials as supports in the stabilization of metal nanoparticles. On this basis, for first time, we herein report the nano-architectonics preparation and characterization of a catalyst consisting of rhodium nanoparticles supported on a parent and a silica intercalated magnesium aluminum hydrotalcite (RhMAHT). The synthesized materials show uniformly dispersed Rh nanoparticles on the MAHT layers (HR-TEM images) and promising catalytic activity in the hydroisomerization of 1-octene.

2. EXPERIMENTAL SECTION

2.1. Synthesis of Silicate Intercalated MAHT

The parent and silicate intercalated MAHT materials were synthesized using the literature procedures.[18, 20, 21]

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