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Metal nanoparticles for multigram upgrading of terpenic renewables through biphasic hydrogenation

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PURPOSE OF THE ABSTRACT

Terpenes constitute a natural and renewable source of raw materials for specialty chemistry. Their upgrading often involves one or more hydrogenation steps, historically catalyzed by Raney nickel, Adams' catalyst or palladium on carbon. Currently, the design of atom-economy and selective reactions, using stable and highly efficient catalysts in green solvents and under mild reactions, is crucial to reduce the waste stream and energy in chemical industry and still constitutes a main challenge in the drive towards economically viable and sustainable processes.[1]

In the context of a collaboration with the DRT company (Dérivés Résiniques et Terpéniques, Castets, France), ruthenium nanoparticles (d < 3 nm) finely dispersed in water and stabilized by easily synthesized ammonium surfactants were prepared in situ and characterized with Transmission Electron Microscopy and in an original way through Turbiscan analyses. These catalysts proved to be highly active and selective under mild conditions in the selective hydrogenation of alpha-pinene into cis-pinane with a Total TurnOver Number of 14 000.[2] This relevant biphasic approach allows the separation of the catalyst and the product by simple decantation. Successfully, an unprecedented scale-up of the optimized process was successfully performed at low metal loading (< 0.01 mol%) on more than 200 g of substrate. To validate the potential of metallic nanoparticles for industrial multiphasic processes, two other valuable transformations for fragrance industry will be presented: i) the regioselective hydrogenolysis of epoxides to alcohols,[3] and ii) the chemoselective reduction of citral to citronellal (Figure 1).

FIGURES

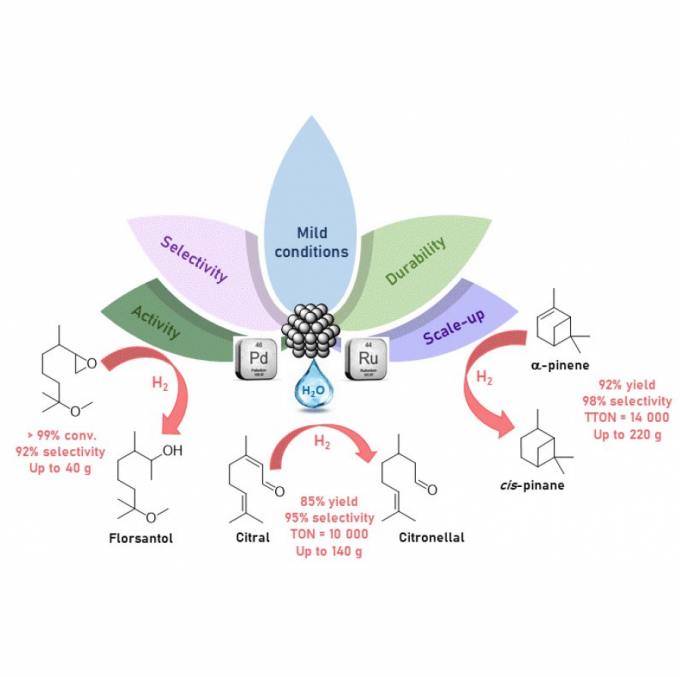

FIGURE 1

Figure 1.

Upgrading terpenes through biphasic nanoparticles-catalyzed hydrogenation processes

FIGURE 2

KEYWORDS

Nanoparticles | Hydrogenation | Terpenes | Scale-up

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