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Development and applications of heterogeneous catalysts made from agricultural (rice) bio-waste

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PURPOSE OF THE ABSTRACT

Rice Husk is one of the main side products in the rice production, and its sustainable management represents a challenge in many countries. The current practice of open-field burning at the harvesting sites results in massive emissions of green-house gases and particulate matter. The unique structure of RH consists of a lignocellulose matrix decorated with silica nanoparticles (up to 20 wt% silica) and, unlike other bio-derived feedstocks like chitosan, RH does not need to be isolated or purified in a complicated manner for its utilization.
Herein we describe the use of this abundant agricultural bio-waste feedstock for the preparation of heterogeneous catalysts for hydrogenation reactions. The catalysts were prepared by impregnating the milled RH with a metal salt solution followed by carbothermal reduction. The tested metals include silver, cobalt, and nickel. The composition and morphology of the prepared catalysts were fully assessed by IR, AAS, ICP-MS, XPS, XRD and STEM techniques. These novel bio-genic metal-based catalysts showed excellent activity and remarkable selectivity in the hydrogenation of nitro and epoxide groups, even in the presence of reactive functionalities like halogens, carbonyls, borate esters or nitriles. Recycling experiments showed that the catalysts can be easily recovered and reused multiple times without significant drop in performance and without requiring re-activation. Thus, these catalyst outperform other ?classic? and bio-derived catalysts, not only in terms of general activity under milder conditions, but also in other relevant aspects like reaction rate, recycling stability, and substrate scope including the commonly neglected aliphatic substrates.
We foresee that the implementation of this methodology within a bio-refinery concept in rice-farming communities is feasible within a reachable timescale (which is the overall goal of the consortium this project belons to). The success of said bio-refinery can effectively tackle some of the most relevant sustainable development goals (SDG) for agricultural societies, addressing economic growth, innovation, industrialization, and improvement of production and recycling patterns, while reducing the nefarious footprint of human activities on the planet.

FIGURES

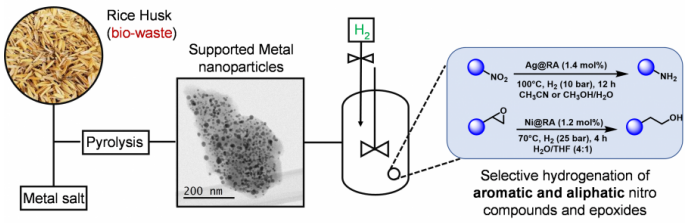

FIGURE 1

Preparation of Hydrogenation Catalysts from Bio-waste

General methodology for the synthesis and application of metal-containing heterogeneous catalysts from agricultural (rice) waste.

FIGURE 2

KEYWORDS

Bio-waste Valorization | Heterogeneous Catalysis | Hydrogenation | Sustainability

BIBLIOGRAPHY

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