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# Bimetallic RuNi nanocatalysts for upgrading biomass resources


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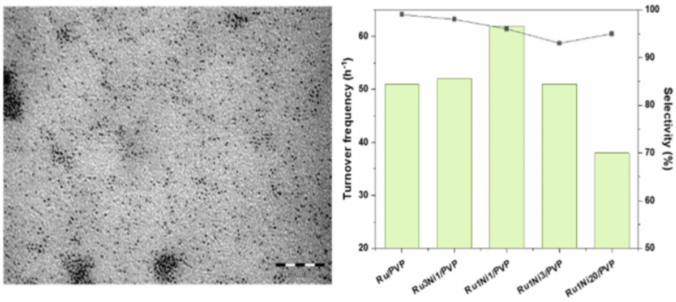
## PURPOSE OF THE ABSTRACT


For a more sustainable chemistry, the exploitation of renewable resources offers solutions. For this purpose, the design of adapted and efficient catalysts is required to face the complex transformation processes of renewable sources. The barrier between homogeneous and heterogeneous catalysis is now reduced thanks to a wider knowledge in nanocatalysis.[1] Many efforts are devoted to access well-defined metal nanoparticles in order to have model systems to study the relationship between their characteristics (composition, chemical order, structure, etc.) and their catalytic performance for key reactions. A challenge is to be able to improve the design of nanocatalysts to easily access target catalytic properties.
The ?Engineering of Metal Nanoparticles? team at LCC-CNRS (Toulouse, France), has developed an efficient toolbox for the synthesis of controlled metal nanoparticles by using the concepts of molecular chemistry, i.e. by hydrogenation of organometallic/metal organic complexes in mild conditions (r.t; 3 bar H2).[2] This approach leads to nanoparticles of controlled size and composition, either monometallic or bimetallic (alloy, core-shell, surface-decorated) and also supported (on silica or carbon supports among others) that can be used as suitable models for investigations in catalysis. Attractive properties are obtained in catalysis[3] and energy[4] fields, including the upgrade of CO2[5] and biomass.[6]
This will be here illustrated through recent results for furfural and 5-hydroxymethylfurfural hydrogenation. These two platform molecules from cellulosic biomass, can produce, via selective hydrogenation, a plethora of interesting compounds, among which methylfuran or 2,5-dimethylfuran, respectively, that are potential biofuels.[7,8] In our study,[9] a family of ultra-small (<2nm) RuNi nanoparticles was successfully prepared on which the ratio of both metals is controlled straightforwardly. These RuNi based nanoparticles efficiently catalysed the selective reduction of furfural and 5-hydroxymethylfurfural, showing a synergetic effect between both metals. DFT calculations allowed to get insights on the coordination mode and strength of the species present during catalysis. The theoretical results are in line with the experimental data, thus supporting well the activity and selectivity found.

## FIGURES




## FIGURE 1

Figure

Left, TEM image of Ru1Ni1: Right, Turnover frequency (bars) and selectivity towards 2-(hydroxymethyl)furan (dots) as function of catalysts in the selective hydrogenation of furfural

## FIGURE 2


## KEYWORDS

biomass | nanocatalysis | bimetallic nanoparticles | selective hydrogenation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