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An heterogeneous process intensified by microwaves for organocatalyzed Knoevenagel Reaction

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PURPOSE OF THE ABSTRACT

Sustainability in chemical synthesis is one of the main objectives nowadays, meant to be addressed by maximizing the industry production efficiency and minimizing the environmental costs. In order to develop an eco-friendlier relationship with our planet, the society has created new legislations which encourage the design of organic reactions using greener strategies such as the combination of microwave heating with effective, low cost and reusable catalysts.

One powerful and commonly used reaction for the formation of carbon-carbon bonds is the Knoevenagel condensation, an addition of a carbanion to an electrophilic carbonyl group in the presence of a weak base. Several reaction methodologies have been reported so far in literature and the interest is mainly focused on the development of environmentally and economically friendly reaction protocols. In this work, the Knoevenagel reaction was tested using 1,4-diabycyclo [2.2.2] octane (DABCO) an organic molecular catalyst (organocatalyst) which is attractive due to its easy reproducibility and low cost.

Various experimental conditions have been tested in order to obtain a greener protocol. The major drawback found was the difficulty to recycle the organocatalyst used due to its inherent instability and miscibility with solvents (2). To facilitate the reuse of the catalyst, the immobilization of DABCO over the mesoporous silica MCM-41 was done. To the best of our knowledge this was done for the first time in literature. This supported catalyst was tested under the conditions same as its homogenous analogue (DABCO). It resulted in the same efficiency in addition to the fact that it could be recovered from the reaction mixture and reused without any significant loss of activity.

In this investigation, the objective was not only limited to a cleaner protocol but also extended to energy efficiency. The latter was achieved by coupling the process with microwave heating which resulted in a significant reduction in reaction time, precise control of temperature and hence better energy efficient. The combination of these techniques promise to be an interesting way to intensify Knoevenagel condensation based processes.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Heterogeneous catalyst | Knovoenagel reaction | Microwaves

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