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One-pot Suzuki/Sonogashira and nitro-reduction in aqueous media using a magnetic nanocatalyst

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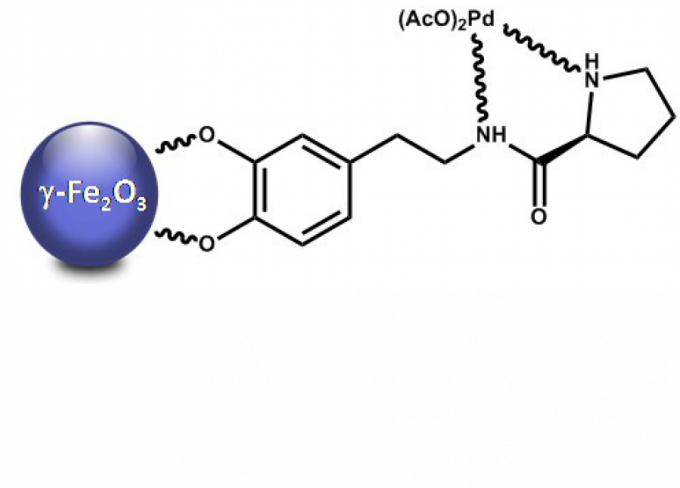
PURPOSE OF THE ABSTRACT

In recent years, the use of nanomaterials in catalysis has attracted many research endeavours around the world in order to develop innovative and greener protocols. These nanomaterials can be used as the catalyst, as the support or simply to facilitate the catalytic process. Due to their high surface/volume ratio, nanoparticles (NPs) represent a bridge between homogeneous and heterogeneous catalysis and are a family of prospective materials with a bright future.[1] Hence, NPs as supporting material or as catalyst, provide the benefit of an increased surface area which allows for an increased reaction rate. In addition, nanoparticles may provide additional practical functionalities due to their unique intrinsic properties. For example, magnetic nanoparticles appear as an ultimate nano-support due to their easiness of recovery owing to their magnetic properties. The simple use of an external magnet could afford the rapid recovery of the catalyst without the need of filtration or centrifugation. The interest in catalysis using magnetic nanoparticles as a support is increasing dramatically and several nanomagnetic catalysts were described recently.[2-3] Another aspect of this quest for eco-compatible and less expensive catalysts is the potential use of these nanocatalysts in aqueous media to catalyze pure organic reactions. To overcome the limitation of mass transfer of organic substrates into the aqueous catalytic phase, addition of amphiphiles to the reaction media[4] or precise tailoring of the nanomaterial surface are studied.

In this context, we developped and studied several iron oxide nanoparticles based nanocatalysts for organocatalysis[5-6] or Pd-supported catalysis.[7-8] These latter nanocatalysts (figure 1) turn out to be extremely efficient for C-C coupling reactions working under eco-friendly conditions (in aqueous media and under aerobic conditions) with Pd quantity down to ppm level. These very stable catalysts (> 12 months in water under aerobic conditions) are moreover reusable and produce small amount of palladium leaching. Here we will show that they can also catalyze nitro-reduction reaction (figure 2) and further allow for achievement of consecutive C-C coupling (Suzuki or Sonogashira) and nitro-reduction in a one pot two steps manner.

FIGURES



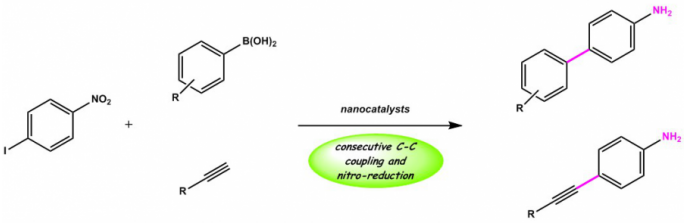


FIGURE 1
Nanocatalyst

Stucture of the palladium-supported magnetic nanocatalyst

FIGURE 2
Catalytic reactions

Consecutive C-C couplings and nitro-reductions with nanocatalysts

KEYWORDS
palladium | nanoparticles | C-C coupling | nitro-reduction

BIBLIOGRAPHY

[1]. Shylesh, S.; Schünemann, V.; Thiel, W.R., Angew. Chem. Int. Ed. 2011, 49, 3428-3459.

[2]. Gawande, M.B.; Branco, P.S.; Varma, R.S., Chem. Soc. Rev. 2013, 42, 3371-3393.

[3]. Terrasson, V.; Guénin, E., Nanomagnetic-Supported Catalysts (chap. 10) in Novel Magnetic Nanostructures (2018), 333-371.

[4]. Lipshutz, B.H., J. Org. Chem. 2017, 82, 2806-2816.

[5]. Nehlig, E.; Motte, L.; Guénin, E., Catal. Today 2013, 90-96.

[6]. Nehlig, E.; Motte, L.; Guénin, E., RSC Adv. 2015, 5, 104688-104694.

[7]. Nehlig, E.; Waggeh, B.; Millot, N.; Lalatonne, Y.; Motte, L.; Guénin, E., Dalton Trans. 2015, 44, 501-505.

[8]. Benyettou, F.; Motte, L.; Traboulsi, H.; Mazher, J.; Pasricha, R.; Olsen, J.C.; Trabolsi, A.; Guenin, E., Chem. Eur. J. 2018, 24, 2349-2353.