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Green synergy of the nanotechnologies and heterogeneous catalysis

Green chemistry is the implementation of the principles aiming at the elimination of the environment pollution. The development of effective catalysts is one of the basic concepts of green chemistry, because they reduce negative ecological impacts by increasing the process selectivity. The advances in nanotechnology manifest a new era in catalysis and provide the tools for the fulfillment of green chemistry requirements. Nanocatalysts have high activity, selectivity and productivity coupled with the ease of catalyst recovery. Nowadays nanoparticles (NPs) are the most important industrial catalysts and have wider application ranging from chemical manufacturing to energy conversion and storage. The nanoscale size, shape and an exceptionally large surface area to volume ratio provide unique properties of the nanocatalysts. The selectivity and activity of nanocatalysts depends on nanocrystal size and morphology as well on their composition. Therefore, efficient control of the NPs properties mentioned above is a task of paramount importance in order to create the advanced catalytic systems in line with green chemistry philosophy. This work aims at the elucidation of the separate role of the factors contributing in nanocatalysts activity and selectivity, i.e. size, shape and support or ligand effects. Our approach involves the controllable preparation of the nanocatalysts composed of Pd, Fe, Au, and Co nanoparticles with different sizes (1-40 nm) and diverse morphologies supported on the inorganic (TiO_2, mesoporous MCM silica) materials, actviated carbon and porous coordination polymers using various techniques. We tested the novel nanocatalysts in different important reactions, i.e. hydroamination, hydrogenation, carbonylation and Fisher-Tropsh synthesis. This study results to differentiate the strong impact of the NPs size, shape and composition on the nanocatalysts performance, that is particular for each studied reaction. Thus, our findings pave the way to the better administration of the nanocatalysts activity and selectivity for the atom-economy, wasteless and energy-efficient processes.

Recent Publications

1. Isaeva V I et al. (2016) Fischer – Tropsch synthesis over MOF-supported cobalt catalysts (Co@MIL-53(Al)). 45(30):12006-12014.
2. Isaeva V I and Kustov L M (2016) Catalytic hydroamination of unsaturated hydrocarbons. Topics in Catalysis. 59(13-14):1196-1206.
3. Isaeva V I et al. (2015) *In situ* synthesis of novel ZIF-8 membranes on polymeric and inorganic supports. Journal of Materials Chemistry A. 3(14):7469-7476.
4. Isaeva VI et al. 2015) Control of morphology and size of microporous framework MIL-53(Al) crystals by synthesis procedure. Mendeleev Communications. 25(6):466-467.
5. Ananikov V P et al. (2016). Challenges in the development of organic and hybrid molecular systems. Mendeleev Communications. 26:365-374.

Biography

Vera Isaeva (1962) is a leading Researcher in National University of Science and Technology "MISIS", Moscow, Russia. Her activity is focused on the development of nanostructured materials including nanocatalysts, nanoporous supports like MOFs and composites on their basis from synthesis to application, especially for green chemistry processes. She has co-authored over 10 publications in peer-reviewed journals, 15 patents and 2 book chapters.

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