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Liquid-phase hydrodehalogenation on metal containing nanodiamonds

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Abstract

Palladium, platinum, rhodium-containing nanodiamonds with a metal content of 0.5 wt. %, 1 wt. % and 2 wt. % based on detonation nanodiamonds brand of RUDDM 0-500 Nizhny Novgorod firm Real-Dzerzhinsk and nanodiamonds brand of the UDD-STP and the UDD -TAN2 with negative and positive ξ-surface potential of the company SKTB Technolog (St. Petersburg) were synthesized. Palladium-containing activated carbon (brand of the PHO M200) of 0.5 wt. % and 1 wt. % was prepared in a similar condition from to compare the catalytic properties of a catalyst containing. Activated carbon was prepared from coconut shell by Evrokarb (UK). Qualitative and quantitative composition of the catalysts was defined by energy dispersive X-ray spectroscopy method, fixation of metal on the surface of nanodiamonds was proved. Samples of metal-containing nanodiamonds and 0.5 wt. % Pd/C, 1.0 wt. % Pd/C were studied in model reactions of hydrodehalogenation of chlorobenzene, bromobenzene and iodobenzene under mild conditions (organic solvent, the temperature of 45 ºC, P_{H_2} = 1 atm) in a single experimental setup. All synthesized metal-containing catalysts were active in model reactions of hydrodehalogenation of monosubstituted of halogenbenzene in the conditions pointed out. It has been shown that the catalytic properties of the systems studied to a great extent depend on the nature of the solvent. In the article show that speed of reactions of hydrodehalogenation of monosubstituted of halogenbenzene is reduced in a number of solvents ethanol > cyclohexanol >> isopropanol. The reaction of benzene and hexane is not, apparently due to the fact that in aprotic solvents heterolytic dissociation of hydrogen molecules on palladium occurs worse than in alcohols. Maximum reaction rate of hydrodehalogenation observed in ethanol. The most active catalysts of hydrodehalogenation in the liquid phase were palladium-containing nanodiamonds. It is shown that the use of a mixed solvent (ethanol-borate buffer) reduces of the reaction time of hydrodehalogenation of chlorobenzene, bromobenzene and iodobenzene, and can increase the reaction rate and yield of the desired product (benzene) to practically quantitative. Also, it is shown that the nature of the metal carrier (nanodiamonds) contributes to the catalytic performance of the system and affects the reaction rate and the yield of the product of hydrodehalogenation.

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