

Hydroformylacja w środowisku cieczy jonowych=Hydroformylation in ionic liquids medium.

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Streszczenie

Wprowadzenie1. Zastosowanie cieczy jonowych w reakcji hydroformylacji2. Reakcje hydroformylacji w układach typu SILP (ang. supported ionic liquid phase)3. Imobilizowane kompleksy karbenowePodsumowaniePiśmiennictwo cytowane

The hydroformylation reaction was discovered by Otto Roelen in 1938. He studied the side processes occurring during the Fischer-Tropsch synthesis with a cobalt catalyst and found some amounts of aldehydes formed from the olefin and syngas (H_2/CO) [1]. The hydroformylation found application in the chemical industry, mainly for production of n-butanal from propene. Aldehydes obtained by propene hydroformylation are subsequently hydrogenated to alcohols, used as solvents. Butanal can also be condensed to C8 aldehydes and alcohols, 2-ethylhex-2-enal and 2-ethylhexanol, important components for plasticizers such as dioctylphthalate. The hydroformylation reaction can be applied not only for the synthesis of aldehydes but also for other products. In particular, successful synthesis of quaternary carbon centers by hydroformylation has been reported in which the rhodium catalyst was modified with a ligand that serves as a catalytic directing group by covalently and reversibly binding to both the substrate and the catalyst. Ionic liquids have been recognized as a novel class of solvents which can be successfully used for homogeneous catalysis [4]. Application of ionic liquids, non-aqueous and non-volatile solvents, has made it possible to construct biphasic systems in order to efficiently separate catalysts from organic products. It is also important that the properties of ionic liquids, such as solubility, acidity, or coordination ability, can be tuned by the use of different cations and anions. In the ideal case, the ionic liquid is able to dissolve the catalyst and displays partial miscibility with the substrate. If the products have negligible miscibility in the ionic liquid, they can be removed by simple decantation, without extracting the catalyst. If the products are partially or totally miscible in the ionic liquid, separation of the products is more complicated [4e, 4h]. The main problem with catalytic systems for hydroformylation containing ionic liquid phase was a significant leaching of the catalyst out of the ionic liquid phase, which can be

overcome by modifying neutral phosphane with ionic groups. Examples of such systems are presented in the article. It was revealed that N-heterocyclic carbenes were formed in the biphasic hydroformylation reactions promoted by Rh complexes in an imidazolium ionic liquid [10]. Consequently, reactivity of the in situ formed Rh-carbene complexes can strongly influence on the hydroformylation reaction course [11]. The best methodology to perform the hydroformylation reaction would be a flow system in which the catalyst remains in the reactor and the substrates and products flow continuously into and out of the reactor. For the construction of such a system with soluble rhodium catalysts, ionic liquids could be considered as media used for the immobilization of the catalyst. The first example of continuous flow hydroformylation was reported by Cole-Hamilton [19, 20]. Different Supported Ionic Liquid Phase (SILP) catalysts have been examined in hydroformylation [15–17]. Interestingly, the neutral ligand can be applied efficiently in a continuous gas-phase SILP process, while in a typical biphasic system containing ionic liquid and organic solvent it would leach into the product phase.

Słowa kluczowe

catalysis, hydroformylation, ionic liquids, rhodium, N-heterocyclic carbene

kataliza, hydroformylacja, ciecze jonowe, karbeny N-heterocykliczne

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