

Hydrogenation of Dibenzo-18-crown-6 ether using γ -Al₂O₃ supported

Ru-Pd and Ru-Ni bimetallic nanoalloy catalysts

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ABSTRACT:

Ruthenium-palladium (Ru-Pd) and ruthenium-nickel (Ru-Ni) bimetallic nanoalloy particles with various metal compositions were synthesized by microwave irradiated (MWI) solvothermal technique using PVP (poly-N-vinyl-2-pyrrolidone) as capping agent and ethylene glycol as a solvent as well as reducing agent. Synthesized bimetallic nanoalloy particles were subsequently impregnated onto γ -Al₂O₃ support to obtain supported nanoalloy catalysts. Agglomeration of nanoalloy particles were restricted by excess solvent, simultaneously distilled and recovered after completion of reaction.

Synthesized bimetallic nanoalloy catalysts were used for the hydrogenation of Dibenzo-18-crown-6 ether (DB18C6) at 9 MPa, 120°C temperature and 3.5 h. It was observed that bimetallic nanolloy catalyst synthesized by MWI using Ru:Pd 3:1% (w/w), exhibited higher catalytic activity and resulted 98.9% conversion of DB18C6 with 100% selectivity towards cis-syn-cis dicyclohexano-18-crown-6 ether (CSC DCH18C6).

1. INTRODUCTION:

Crown ether compounds have been widely used for complexation and separation of metal ions, phase transfer catalysis, host-guest chemistry and supramolecular chemistry (Yamato et al. 2002; Landre et al. 1993). Beside other fission products, ^{90}Sr and ^{137}Cs are formed in nuclear reactors. The medium activity water (MAW) produced by the PUREX process, contains a fraction of these two isotopes. Because of their long half-lives (^{137}Cs : 30.1y, ^{90}Sr : 28.5 y), their separation could reduce storage risks and costs of the solidified waste (Blasius et al. 1985). The possible application of crown ethers for the recovery of radionuclides [Sr, Cs, transuranium elements] from real radioactive waste solutions using DCH18C6 and its derivatives have been reported (Abashkin et al. 1996).

The hydrogenation of aromatic compounds is well-documented in the literature as far as parent hydrocarbons are concerned, but is scarcer as regards the stereoselective hydrogenation of substituted aromatics (Landre et al. 1994; Gao et al. 2012; Nandanwar et al. 2013). DCH18C6 is usually produced by the catalytic hydrogenation of dibenzo-18-crown-6 (DB18C6), which yields mainly two stereoisomers, cis-syn-cis-DCH18C6 and cis-anti-cis-DCH18C6, while the cis-syn-cis isomer exhibits greater extractability and