Highly efficient hydrogenation of furfural to valuable products catalysed by Rh (III), Pd (II), Ni (II), Fe (II) and Ru (II) half-sandwich picolinamide and the SBA-15 supportedmolecular complexes as pre-catalysts

Pamela S. Moyo Gift Mehlana Leah C. Matsinha Banothile C. E. Makhubela

Abstract

Novel palladium, rhodium, iron, ruthenium and nickel half-sandwich picoli-namide complexes have been prepared and characterised in detail using high-resolution electrospray ionisation mass spectrometry (HR-ESI-MS), multi-dimensional nuclear magnetic resonance spectroscopy, elemental analysis (EA), Fourier transform-infrared spectroscopy (FT-IR), and single crystal X-raydiffraction (SCXRD). All the systems proved to be active with good catalyticperformance for the hydrogenation of furfural. Among the pre-catalyst, C2(Rh metal centre) displayed complete conversion (100%). Pre-catalyst C5(Ru metal centre) also resulted in excellent selectivity to EL (51%) and FA (49%). All the pre-catalysts with early transition metal centres (Ni, Fe) gaveselectivity towards FA (100%) under optimal conditions. Possible pathways forthe formation of catalytically active have been proposed based on in situ NMRstudies obtained using C2. Successful modification of molecular complexes (C2and C3) on SBA-15 resulted in supported molecular complexes (C2@SBA-15and C3@SBA-15). Furthermore, the supported molecular catalysts were char-acterised using inductively coupled plasma-optical emission spectroscop (ICP-OES), Fourier-transform infrared spectroscopy (FT-IR), powder X-ray dif-fraction (PXRD), BET surface area, selected area electron diffraction (SAED), X-ray photoelectron spectroscopy (XPS) and high-resolution transmission elec-tron microscopy (HR-TEM). The supported molecular complex C2@SBA-15was recycled five times (with consistent activity and selectivity).

KEYWORDS