Development of cellulose-supported Pd-nanocatalyst for the heck coupling and michael addition reactions

ABSTRACT

The development of reusable, bio-resource based nanocatalysts with high turnover numbers (TONs) is essential for increased sustainability in the chemical sector. Herein, cellulose-supported bio-resourced poly(hydroxamic acid) is employed as a ligand in the synthesis of a palladium nanocomposite (PdNc-PHA) that exhibits higher TONs that previously reported similar systems for the Mizoroki-Heck and Michael addition reactions. The PdNcPHA catalyst was characterised using Fourier transform infrared spectroscopy (FTIR), field-emission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectrometry (EDX), high-resolution transmission electron microscopy (HR-TEM), X-ray photoelectron spectroscopy (XPS), and inductively coupled plasma-atomic emission spectroscopy (ICP-AES) analyses. Results showed that the PdNc-PHA catalyst exhibits excellent durability and high catalytic activity in the Mizoroki-Heck and Michael addition reactions, leading to high yields of the desired corresponding products. The Mizoroki-Heck reaction of aryl/heteroaryl chlorides with olefins resulted in the production of cross-coupled products, while the Michael addition reaction of phenol/thiophenol and aliphatic cyclic/alicyclic amines with a variety of olefins synthesised the corresponding O-, S-, and Nalkylated products. The recycle and reusability of the catalyst were tested using 4-nitrochlorobenzene and butyl acrylate. The results demonstrated that the catalyst maintained its catalytic activity effectively for up to ten cycles without any noticeable loss in performance. This research represents a promising strategy for efficient catalysis based on bio-waste as a wealth material.