Abstract

Use of heterogeneous metal catalysts has facilitated synthesis of many industrially important chemicals. Nanostructuring of such metals is one of the ways to enhance their catalytic activity by enhancing their surface to volume ratio. Among various noble metal catalysts, Pd is considered to be the most important one as it is used as catalyst in many organic transformations such as nitro-to-amine reduction, various cross coupling reactions etc. We have synthesised palladium nanowires (Pd NWs) with high aspect ratio that can form network structure, by galvanic displacement using in-situ synthesised tellurium nanowires (Te NWs) as sacrificial agent. Catalytic activity of as-synthesised Pd NWs was investigated in reduction of 4-nitrophenol (4-NP) to 4-aminophenol (4-AP) using sodium borohydride as reducing agent which achieved complete conversion within 20 seconds. The rate constant (pseudo first order) 0.1055 s-1 and turnover frequency (TOF) of 4200 s-1g-1 of Pd NWs is very high when compared to other catalysts reported in literature as well compared to in-situ synthesised catalysts such as palladium nanorods (Pd NRs), palladium nanoparticles (Pd NPs) and palladium on carbon (Pd-C). The catalytic reduction of other nitro-compounds like 2-nitrophenol and 2,4,6-trinitrophenol is investigated. Further, we are trying to configure a lab scale continuous flow column reactor using Pd NWs membrane on filter paper which can demonstrate efficient reduction of 4-NP to 4-AP using it. Pd NWs is superior to current catalysts, in terms of catalytic efficiency, recycling stability and formation of catalyst bed for flow reactor, which indicated the possibility of realising industrial production of 4-aminophenol in near future.