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Green Catalytic Conversion of Some Aromatic Alcohols to Acids by NiO_2 Nanoparticles (NPNPs) in Water

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Abstract : The basic aqueous systems $NiSO4.6H_2O$ / $K_2S_2O_8$ (PH= 14) or $NiSO_4.6H_2O$ / $KBrO_3$ (PH = 11.5) were investigated for the catalytic conversion benzyl alcohol and some para-substituted benzyl alcohols to their corresponding acids in 75-97 % yield at room temperature. The active species was isolated and characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray powder diffraction, EDX and FT-IR techniques and identified as NiO_2 nanoparticles (NPNPs). The SEM and TEM images of nickel peroxide samples show a fine spherical-like aggregation of NiO_2 molecules with a nearly homogeneous partial size and confirm the aggregation's size to be in the range of 2-3 nm. The yields, turnover (TO) and turn over frequencies (TOF) were calculated. It was noticed that the aromatic alcohols containing para-substituted electron donation groups gave better yields than those having electron-withdrawing groups. The optimum conditions for this catalytic reaction were studied using benzyl alcohol as a model. The mechanism of the catalytic conversion reaction was suggested, in which the produced (NPNPs) convert alcohols to acids in two steps through the formation of the corresponding aldehyde. The produced NiO, because of this conversion, is converted again to (NPNPs) by an excess of $K_2S_2O_8$ or $KBrO_3$. This catalytic cycle continues until all the substrate is oxidized.

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