Nanorods assembly of Mesoporous Boehmite Film on Glass: An Efficient Catalyst for Permanganate Reduction to MnO_2 Nanoparticles

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Electronic Supplementary Information (ESI)

The decomposition of $KMnO_4$ to MnO_2 NPs is observed to be catalyzed by the unique nanorods assembly of mesoporous boehmite films. For a comparison the reaction was also checked using one commercially available boehmite powder Disperal P2. Since P2 contains nitric acid (checked by FTIR and found nitrate peak at ~1350 cm^{-1}), we heat-treated the powder at 300 °C for 2h to remove the nitric acid and water prior to use. The heat-treated powder was also checked by FTIR and XRD. FTIR showed absence of nitrate peak and presence of characteristic peaks of boehmite. XRD also showed characteristics diffraction peaks corresponding to the boehmite (JCPDS PDF # 00-017-0940; 01-073-6509) without any preferred crystallographic orientation. The BET surface area and average pore size value of this heat-treated P2 were estimated by N_2 sorption analysis and found to be 203 m^2g^{-1} and 3.39 nm respectively.

The calculated (considering the density, film thickness and area; also checked by the weight difference of the uncoated and coated substrate) weight of boehmite film material used for the catalytic purpose was found to be 0.0008 ± 0.00005 gm. We have monitored the $KMnO_4$ decomposition reactions at pH 7 in presence of the heat-treated P2 boehmite powder of 0.0008 (equivalent amount of the film material) and 0.0032 gm (4 times higher). In the former case a slight decrease of the absorption intensity of the set of bands near 545 nm (Fig. S1) was observed after 5 h. In the later case (using of 4 times higher P2) a relatively more decrease in intensity of the set of bands ~545 nm (Fig. S2) was observed. It can be noted here that in these cases no noticeable absorption peak corresponding to the MnO_2 NPs was observed in the UV-visible spectrum (Figs. S1 and S2). It seemed that the $KMnO_4$ was getting adsorbed by the porous boehmite powder and for this reason an overall decrease in intensities of $KMnO_4$ related peaks were observed. This result confirmed that the developed nanorod assembled boehmite film is very much active towards the reduction of $KMnO_4$ to MnO_2 NPs due to its unique nanorod structure with preferred orientation.

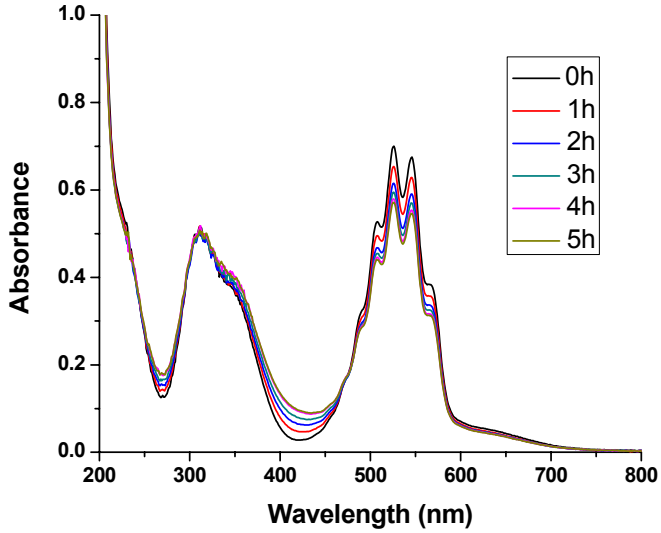

Fig. S1. UV-visible spectra of $KMnO_4$ solution (pH 7) in the presence of 0.0008 gm heat-treated boehmite powder (P2) recorded up to 5 h.

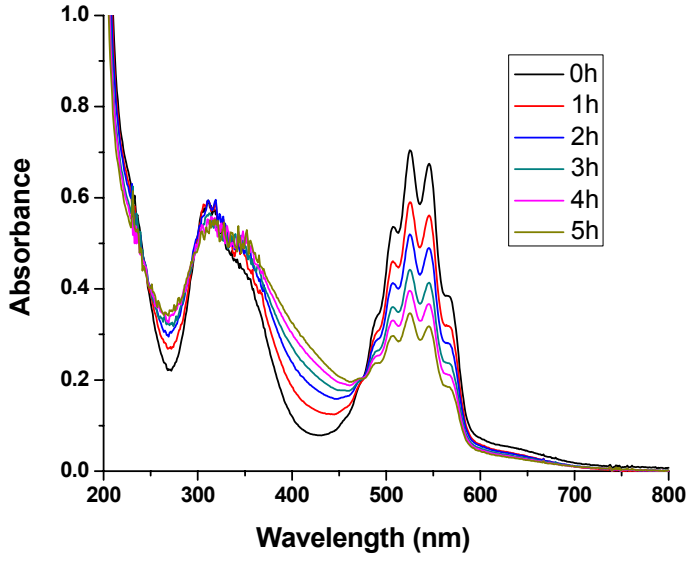

Fig. S2. UV-visible spectra of $KMnO_4$ solution (pH 7) in the presence of 0.0032 gm heat-treated boehmite powder (P2) recorded up to 5 h.