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Materials chemistry and applications

Amphiphilic carbon nanotubes for catalytic wet peroxide oxidation of 4-nitrophenol

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Carbon nanotubes (CNTs) were synthesized via chemical vapor deposition (CVD) over an $AlCoFeO_4$ catalyst by a sequential feed of ethylene (E, as carbon source) and acetonitrile (A, as nitrogen source). The resulting samples were noted E20 (hydrophobic), E10A10 (amphiphilic), and A20 (hydrophilic), the number referring to the feed time (minutes) of each precursor, as reported elsewhere[1]. These materials were tested in the catalytic wet peroxide oxidation (CWPO) of 4-nitrophenol (4-NP). The reaction was monitored by HPLC (to determine the concentration of 4-NP and respective intermediates), TOC analyzer, and UV-vis spectrophotometry (to quantify H_2O_2) (Figure 1). After 8 h of reaction, A20 led to the highest consumption of H_2O_2 (90%), followed by E10A10 (61%) and E20 (52%). On the other hand, the highest degradation of 4-NP was observed with the amphiphilic E10A10 material (98%) followed by E20 (95%), whereas A20 only led to a removal of 69%. Similar behavior was found when analyzing the formation of reaction intermediates (data not shown), i.e., while A20 resulted in the accumulation of 4-nitrocatechol (4-NTC) and hydroquinone (HQ) E10A10 and E20 led to the total conversion of formed 4-NTC and HQ. This resulted in a lower TOC removal for A20 (37%) than to E10A10 and E20 (53%). Therefore, the amphiphilic E10A10 material is a promising catalyst for the CWPO of 4-NP.

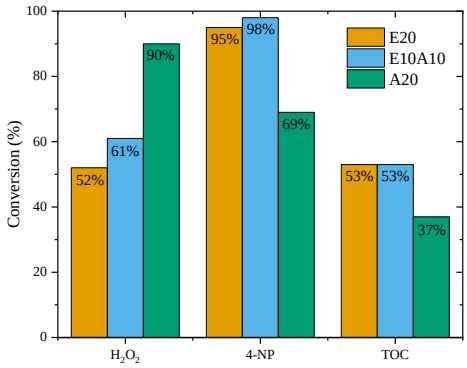

Figure 1: CWPO of 4-NP (operating conditions: $[4\text{-NP}]_0 = 1$ g L^{-1}, $[H_2O_2]_0 = 3.6$ g L^{-1}, [catalyst] = 2.5 g L^{-1}, 80 °C, pH 3.5, 8 h).

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