Graphene-Based Materials in Catalytic Wet Peroxide Oxidation

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In catalytic wet peroxide oxidation (CWPO), an advanced oxidation process, hydrogen peroxide (H_2O_2) is decomposed catalytically giving rise to hydroxyl radicals ($HO^{\bullet}$). These radicals, exhibiting high oxidizing potential, serve as effective and non selective species for the degradation of several organic pollutants in liquid phase. Since the report of Lücking et al. [1], carbon materials have been explored as catalysts for CWPO [2]. Recent reports address process intensification issues, broadening the window of industrial applications for this wastewater treatment technology [3]. In this work, graphene-based materials were tested for the first time as catalysts for CWPO.

Three samples of reduced graphene oxide were obtained by chemical reduction of exfoliated graphene oxide (GO_{exf}), with vitamin C (rGOV), glucose (rGOG) and hydrazine (rGOH). All the materials were tested as adsorbents and as catalysts in CWPO, considering 5 g L^{-1} 4-nitrophenol aqueous solutions (4-NP), 50°C, pH 3, load of catalyst = 2.5 g L^{-1} and, in CWPO runs, $[H_2O_2]$ = 17.8 g L^{-1} (stoichiometric amount needed for the complete mineralization of the pollutant).

Graphene-based materials are effective catalysts for CWPO of highly concentrated 4-NP (Fig. 1). From characterization results it was found that the activity of the materials is correlated with their surface chemistry, favoured by less acidic materials, and with the amount of defects in the structure.
Results here described concerning 4-NP conversion will be useful for broadening the range of potential applications of CWPO under intensified conditions using novel graphene-based catalysts.

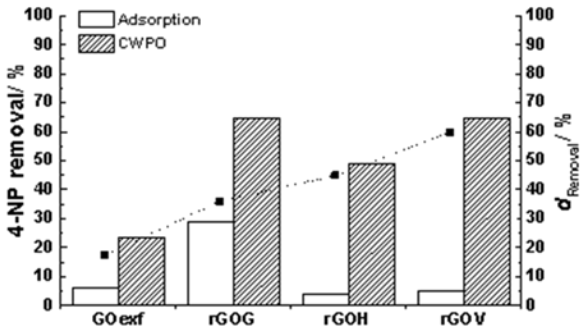

Fig. 1. 4-NP removal in adsorption and CWPO runs (bars/left axis) after 24 h, and difference between CWPO and adsorption removal [$d_{Removal}$ (squares/right axis)]

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