Synthesis and application of vanadium nanostructured material for electrosynthesis of hydrogen peroxide

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The development of processes for efficient degradation of persistent organic pollutants in the environment has attracted a great deal of interest[1]. Between the known process, Advanced Oxidation Processes (AOP) which use strong oxidizing agents such as O_3 and H_2O_2 and/or catalysts as Fe and TiO_2 to produce the hydroxyl radicals (OH•) has some advantages, since the hydroxyl radicals reacts strongly with all organics by hydrogen abstraction, oxidizing them to very low concentration or by their complete mineralization [1,2]. Hydrogen peroxide can be electrochemically generated by the two-electron pathway of the oxygen reduction reaction (ORR) and carbon is a well know cathode for it [3]. In addition, the use of some metal and metal oxides to enhance the activity of the ORR toward two-electrons transference is already known [4]. Aiming the improvement of hydrogen peroxide electrogeneration this work reports a comparative study using different proportions of vanadium oxides (1%, 6%, 12%, 15% and 20%) supported on Vulcan XC72R carbon. The V/C materials were prepared by the polymeric precursor method (PPM) [5] and after compared to the materials prepared by the mass method (MM), comprising commercial vanadium oxide, with higher particle size. The materials were physically characterized by X Ray Diffraction (XRD) and electrochemically characterized by cyclic voltammetry. The ORR was studied using the ring-disc technique in NaOH 1 mol L^{-1}. The results showed that the V/C 12% prepared by the PPM was the best for the production of H_2O_2, for this material, the number of electrons transferred and the H_2O_2 percentage efficiency was 2.6 and 68 %, respectively, while the V/C 12% prepared by the MM showed 3.8 electrons transference and 8 % of peroxide production. The ring-current for ORR in V/C 12% PMM was higher than one measured for the same process using Vulcan carbon, the reference material for H_2O_2 production, which produced 41% of H_2O_2 with the transference of 3.1 electrons per oxygen molecule. Hence, the V/C 12% electrocatalyst prepared by PMM is a promising material for the H_2O_2 eletrogeneration. Their behavior can be explained by the type of vanadium oxide produced and the mean particle size measured.

Keywords: Hydrogen Peroxide, Oxygen Reduction Reaction, Electrocatalysts, Vanadium.

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