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Evaluation of the precursor and hydrothermal conditions to obtain titanate structures applied to the photodegradation of rhodamine B

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Abstract

Titanate structures can be obtained by hydrothermal method in highly alkaline conditions. Most of the works presents only TiO2 as precursor and highly alkaline conditions (strong bases at concentrations ranged from 5 to 10 mol.L-1) [1]. On the other hand, there is a lack of studies that examine other precursors in order to obtain titanates at soft conditions. Then this study presents the synthesis of titanates by hydrothermal route using 4 precursors, 2 commercial precursors (TiO2 and titanium isopropoxide) and 2 peroxy complexes of titanium.

The peroxy complexes were obtained through decomposition of metallic titanium and titanium isopropoxide according to previous works [2,3] resulting to the precursors named as TiO/peroxy complex of titanium and isopropoxide/peroxy complex of titanium, respectively. After synthesis of precursors, it was made the hydrothermal treatment (200°C/2 h) in KOH solution at 0.01, 0.1 and 1 mol.L-1. Then, dialysis was performed to clean the obtained material that was lyophilized to obtain the powder for further characterizations. The materials were characterized by X-ray diffraction, surface area, scanning electron microscopy and their photocatalytic potential was evaluated for the degradation of rhodamine B through monitoring the dye concentration with UV-Vis spectrometry. The results showed that the precursors of peroxy complexes of titanium and titanium isopropoxide produced titanate sheets in less alkaline conditions than previous works. In 1 mol.L-1 concentration all of precursors resulted in the TiO2 anatase formation after hydrothermal treatment being obtained a phase mixture of anatase-titanate for the isopropoxide/peroxy complex of titanium. In 0.1 mol.L-1 concentration, the hydrothermal treatment resulted in the titanate formation for all precursors, except for TiO2 that did not result in the formation of titanate in the studied conditions. Also, the titanates showed low photoactivity compared to anatase phases and the material obtained using isopropoxide/peroxy complex of titanium at 0.01 mol.L-1 showed high photoactivity. This high photoactivity can be attributed the presence of the anatase-titanate heterojunction.

References