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Multiphase photo-capillary reactors coated with TiO_2 films: preparation, characterization and photocatalytic performance

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Abstract

Quartz capillaries were assessed as multiphase photocatalytic reactors. The tested reaction was the salicylic acid (2-dihidroxibenzoic acid) oxidation. The catalyst (TiO_2) was either in slurry or immobilized by sol-gel method onto the capillary wall. All experiments were conducted under oxygen flow and Taylor flow hydrodynamic regime. TiO_2 Films were characterized by Raman spectroscopy, diffuse reflectance UV-Vis spectroscopy and scanning electronic microscopy. The effect of two synthesis variables was established. These variables were volumetric ratio of precursors solutions (i-PrO:2-propanol:nitric acid) and number of capillary coating cycles. These variables were found to importantly affect film homogeneity and oxidation rate. The highest initial reaction rate (106.32×10^{-6} mol $dm^{-3}s^{-1}$) was obtained when using the TiO_2 as film prepared with a precursors volumetric ratio of 1:15:1 and with two coating cycles. For comparison purposes, the same oxidation process was conducted in a stirred reactor and it was found that the reaction rate value is diminished by almost four times in comparison with that obtained under Taylor flow in the capillary reactor. Selectivity was found to be dependant on the type of catalyst addition, slurry or immobilized. Catalytic films employed in this non-common reaction system were

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