Characterization of improved copper doped CeO_2 nanoparticle catalyst

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CeO_2 nanoparticles have been synthesized by a simple hydrothermal method [2]. After synthesis, samples were washed and tempered at 500ºC for 4h either oxidative or reductive atmospheres. Their catalytic activity was evaluated by degradation of rhodamine 6G at room temperature in the presence of hydrogen peroxide, and compared with undoped CeO_2 nanoparticles (figure 1). Nanoparticles doped with 10 % of copper showed strongly increased catalytic performance. Samples were characterized by X-ray diffraction, micro-Raman and BET surface analysis. Electron paramagnetic resonance (EPR) was used to study the copper incorporation sites in the CeO_2 nanoparticles (figure 2). From the EPR spectra we suggest that Cu^{2+} ions occupy interstitial sites in the fluorite lattice of the CeO_2. EPR spectra of aqueous dispersions of catalyst and spin trapping agent DMPO by application of H_2O_2 allowed us to identify and quantify the main reactive oxygen radicals responsible for the degradation of rhodamine 6G. The increased catalytic activity of the copper doped CeO_2 nanoparticles is explained by enhanced concentration and mobility of oxygen vacancies, and in addition to the enhanced redox pair Cu^{+}/Cu^{2+} in the CeO_2: Cu system.

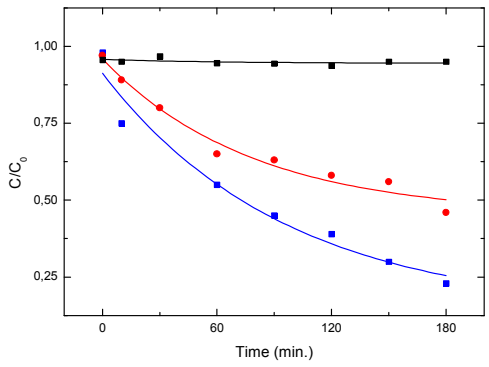

Figure 1: Degradation of rhodamine 6G by CeO_2 nanoparticles in the presence of H_2O_2: (red) oxidized Cu-doped, (blue) reduced Cu doped and (black) oxidized undoped CeO_2.

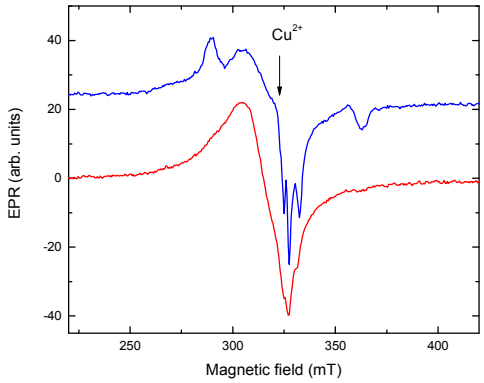

Figure 2: EPR spectra of CeO_2: Cu (10%) measured at 20 K for samples tempered at 500ºC/4h in (red) oxidative and (blue) reductive atmospheres.

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References:

[1] D. Zhang, Y. Qian, L. Shi, H. Mai, R. Gao, J. Zhang, W. Yu, W. Cao. Cu-doped CeO_2 spheres: Synthesis, characterization, and catalytic activity. Cat. Comm. 26 (2012)164-168.