

Direct Synthesis of Hydrogen Peroxide over Pd/C Catalysts : Effect of Physicochemical Properties of Support on the Reaction Performance

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The direct synthesis of H_2O_2 from H_2 and O_2 has drawn attention from its infancy with a hope that the greenest oxidizing agent can be produced via environmentally-benign route with the simple reaction scheme involved [1]. Contrary to the simple reaction scheme, unfortunately, the efficiency of the catalysts remains unsatisfactory and concomitant intrinsic problems such as corrosion and safety issues persist. To prevent corrosion problems caused by the use of caustic acid or halide additives, various types of solid acid supports, *i.g.*, zeolites [2], SO_3H -functionalized materials [3], nanosheets [4] and insoluble heteropolyacids [5] have been applied and found that the nature of supports is important in determining the catalytic performance.

In this study, a range of acid-treated Pd/C catalysts were systematically prepared using two different carbon support such as activated carbon and carbon black, and applied to the direct synthesis of hydrogen peroxide.

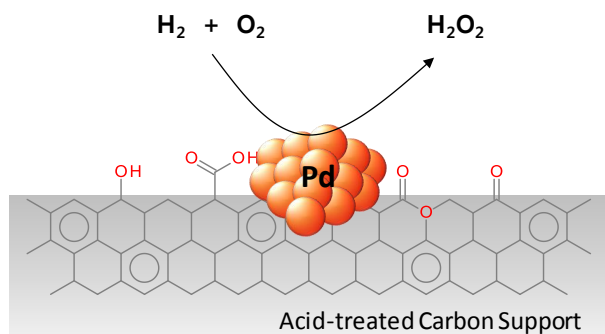


Fig. 1. Direct synthesis of hydrogen peroxide over acid-treated Pd/C catalysts.

To investigate the effect of surface nature of carbon support on the reaction performance of Pd/C catalyst, acid treatments were

performed using 1 wt% HNO_3 , 10 wt% HNO_3 , and 10 wt% HNO_3 / 10 wt% H_2O_2 . The changes in the physicochemical properties of the resulting acid treated carbon supports were characterized by BET, titration, XPS, TPD-mass, and DRIFTS-IR techniques. It was found that not only the nature of oxygen-containing functional groups but also their concentration on the carbon surface largely depended on the carbon support used and the acid treatment conditions.

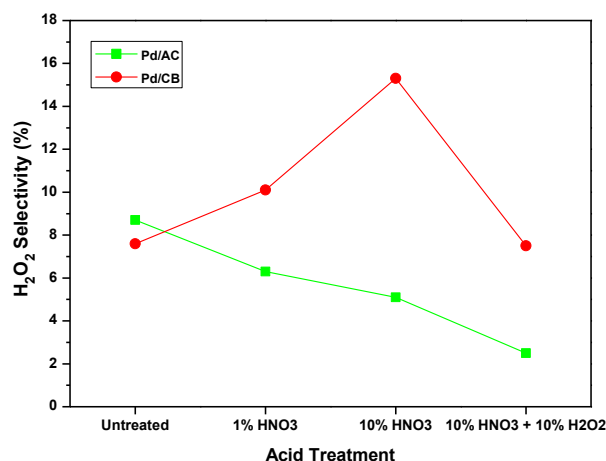


Fig. 2. Effect of acid treatments on the reaction performance.

Activity tests using the acid-treated Pd/C catalysts showed that the feature of support significantly affected on the reaction performance. This result clearly demonstrates that controlling the characteristics of carbon support is of prime importance to realize an efficient Pd/C catalyst for the direct synthesis of hydrogen peroxide from hydrogen and oxygen.

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