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SYNTHESIS AND CATALYTIC PERFORMANCE OF Au-CeO_2 NANOCOMPOSITES FOR THE REDUCTION OF PARA-NITROPHENOL

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ABSTRACT

Gold (Au) nanoparticles supported on cerium oxide (CeO_2) have shown promising catalytic performance for environmental applications, particularly in the reduction of *p*-nitrophenol (*p*-NP). Among various synthesis approaches, depostion-precipitation (DP) and reduction-deposition (RD) are widely used for anchoring Au nanoparticles onto CeO_2. However, achieving well-dispersed, stable Au nanoparticles with high catalytic efficiency remains a significant challenge. Furthermore, there is a lack of comparative studies evaluating the effectiveness of these methods in *p*-NP reduction, creating uncertainty about their relative performance. This study aims to compare the catalytic performance of Au-CeO_2 nanocomposites synthesized via DP and RD methods, using *p*-NP reduction as a model reaction. CeO_2 was first synthesized through chemical precipitation, followed by Au nanoparticles immobilization using DP and RD techniques. In the RD method, two different reducing agents were employed: sodium borohydride (strong reducing agent, RD1) and sodium citrate (weak reducing agent, RD2). The effect of catalyst dosage (1-10 mg) and *p*-NP concentration (0.05-0.20mM) on catalytic activity was systematically investigated. Fourier Transform Infrared (FTIR) spectroscopy confirmed successful Au immobilization through characteristic peak shifts from 520 cm^{-1} (CeO_2 support) to 500 cm^{-1} (DP), 508 cm^{-1} (RD1) and 501 cm^{-1} (RD2). This peak corresponds to O-Ce-O bond. The peaks in the range of 3300–2800 cm^{-1}, corresponding to O-H stretching in CeO_2. All Au-CeO_2 catalysts achieved 100% conversion of *p*-NP to *p*-aminophenol. The calculated rate constant (*k*) was 2.17 x 10^{-3} s^{-1} (DP), 2.15 × 10^{-3} s^{-1} (RD1), and 8.59 x 10^{-4} s^{-1} (RD2). Therefore, the DP method is the best method because it shows the highest rate constant, indicating the fastest reaction. Although all methods achieved 100% conversion, DP provides the most efficient catalytic activity. These findings highlight the importance of the synthesis method and reducing agent in optimizing the activity of Au-CeO_2 catalyts.

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