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Size Controlled Palladium Nanoparticles for Liquid Phase Transfer Dehydrogenation of Alcohols

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Abstract

The transformation of alcohols to aldehydes or ketones is one of the most essential reactions in organic synthesis. An interesting alternative to aerobic conditions to produce oxygenated products, such as aldehydes and ketones, can be the dehydrogenation of alcohols under anaerobic conditions with the utilization of unsaturated organic molecules as hydrogen acceptors, instead of molecular oxygen. In this case, the oxidative dehydrogenation is changed to transfer dehydrogenation, which overcomes the safety limitations of aerobic oxidation. The influence of varying the stabilizer type (PVA, PVP, and THPC) during the synthesis of palladium nanoparticles via sol-immobilization technique on the resulted particles, and their catalytic activity on the liquid phase transfer dehydrogenation of 1-phenylethanol (1-PhEt) has been investigated for the first time. The chemical composition and morphology of the fresh and used catalysts were determined using XRD, XPS, BET, SEM-EDX, and TEM. By evaluating the catalytic activity of the series of 1% Pd/TiO_2 catalysts prepared using different PVA/Pd weight ratio, the results illustrate that two main parameters can mainly control the catalytic activity of 1% Pd/TiO_2 in the liquid phase transfer dehydrogenation of 1-PhEt, these are Pd(0)/Pd(II) ratio and the particle size of the catalyst. The results show that two different regimes can be identified during the liquid phase transfer dehydrogenation of 1-PhEt. At the initial time, the particle size parameter appears to control the catalytic performance of 1-PhEt while the effect of Pd oxidation state starts to take place after reaching iso-conversion, where the percentage of Pd(0)/Pd(II) increases while the reaction proceeds.

Keywords
Transfer dehydrogenation, 1-phenylethanol, palladium, nanoparticles, sol-immobilization

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Biography
Reem Al-Bilali, an assistant professor of physical chemistry at Imam Abdulrahman Bin Faisal University, has 20 years of experience in the academic field and a wide range of research interests, most notably in the field of heterogeneous catalysis. She is interested in number of research topics, including the preparation and characterization of supported metal nanoparticles and testing their catalytic efficiency for gas-phase and liquid-phase reactions. In addition to using catalytic materials in energy-producing reactions, she characterizes catalysts using a variety of analytical techniques. She holds a British Fellowship in Education from Advance HE, and a Postdoctoral Research Fellowship from the Cardiff Catalysis Institute at Cardiff University, UK. She has participated in numerous international conferences and has over 25 published papers in international journals. She has two registered patents

from the United States Patent and Trademark Office. She is a member of the Royal Society of Chemistry (London, UK), the American Chemical Society, and the Saudi Chemical Society.