Sustainable production of aviation fuels directly from palmitic acid

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In recent years, there has been a growing effort to reduce the use of fossil fuels, particularly in the transport sector. In this sense, biomass appears to be a sustainable alternative that could replace oil derivatives, such as petrol and diesel, due to its low cost [1,2,3].

In this work, the process of converting palmitic acid (a model compound from microalgae) through hydrodeoxygenation (HDO) reaction was studied, where the main objective was the formation of hydrocarbons in the aviation fuels range (C_8-C_{16}). To this end, bi- and monometallic catalysts composed of 1-4% Mo and 2.5-10.5% Ru supported on carbon nanotubes (CNT) were synthesized. Catalytic tests were carried out, in which 0.5 g of palmitic acid, 50 mL of solvent (decane or dodecane) and 0.25 g of catalyst were introduced into a batch reactor (Parr Instruments) under stirring at 150 rpm and H_2 pressure of 30 bar. After heating to 350 ºC, the reaction was started and carried out for 6 h, after which the reaction mixture was analysed by gas chromatography-mass spectrometry (GC-MS Shimadzu TQ-8040 NX). The prepared materials were characterised by temperature-programmed reduction (TPR) and N_2 adsorption isotherms. The conversion of palmitic acid and the yield of hexadecane (C_{16}) were calculated, and the effects of the support (CNT and CNT_{ox}), solvent and metal content were assessed.

Based on the results obtained, the catalyst metal content proved to be a determining factor to obtain a higher C_{16} yield. Thus, the catalysts with a higher metal content, namely 2.5%Ru-10.5%Mo/CNT_{ox} and 2.5%Ru-10.5%Mo/CNT, allowed to attain the best results: 60.2% and 57.6% yield of C_{16}, respectively. Among the prepared monometallic catalysts, 10.5%Mo/CNT and 2.5%Ru/CNT_{ox}, the former led to the formation of 29.7% yield of C_{16} and 84% conversion of palmitic acid, while the latter resulted in a C_{16} yield of 3.1% and complete palmitic acid conversion. As for the other parameters evaluated, it was concluded that the use of CNT_{ox} as support and decane as solvent did not significantly affect the results obtained.

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