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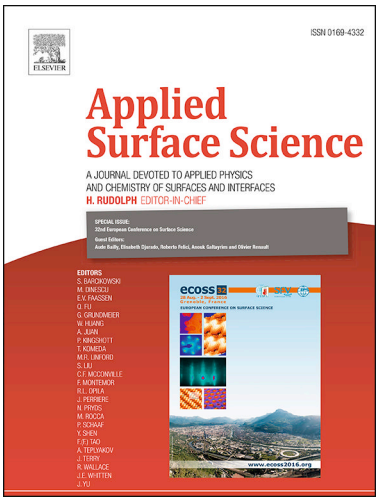

Full Length Article

Surface science approach to Pt/carbon model catalysts: XPS, STM and micro-reactor studies

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Surface science approach to Pt/carbon model catalysts: XPS, STM and microreactor studies

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Abstract

Pt nanoparticles supported on carbon are an important technological catalyst. A corresponding model catalysts was prepared by physical vapour deposition (PVD) of Pt on sputtered HOPG (highly oriented pyrolytic graphite). The carbon substrate before and after sputtering as well as the Pt/HOPG system before and after Pt deposition and annealing were examined by XPS and STM. This yielded information on the surface density of defects, which serve as nucleation centres for Pt, and on the size distribution (mean size/height) of the Pt nanoparticles. Two different model catalysts were prepared with mean sizes of 2.0 and 3.6 nm, both turned out to be stable upon UHV-annealing to 300 C. After transfer into a UHV-compatible flow microreactor and subsequent cleaning in UHV and under mbar pressure, the catalytic activity of the Pt/HOPG model system for ethylene hydrogenation was examined under atmospheric pressure flow conditions. This enabled to determine temperature-dependent conversion rates, turnover frequencies (TOFs) and activation energies. The catalytic results obtained are in line with the characteristics of technological Pt/C, demonstrating the validity of the current surface science based model catalyst approach.

Keywords

platinum; carbon; model catalysts; ethylene; hydrogenation; photoelectron spectroscopy; scanning tunneling microscopy; microreactor