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Pulse-response studies in heterogeneous catalysis: Theory and applications

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Non-steady-state kinetic screening of heterogeneous catalyst using pulse-response studies is based on the original technique of Temporal Analysis of Products (TAP) or “chemical calculus”, which has become popular during the past two decades. Theory, methodology and application of this approach are explained using CO oxidation and hydrocarbon oxidation as examples. The main revolutionary idea of TAP is to treat the catalyst by a series of pulses of very small intensity relative to the amount of catalyst. The change of the catalyst composition caused by every pulse is insignificant. However, a precise mass-spectroscopic technique allows monitoring changes in the composition of the pulsed chemical mixture at the exit of the catalyst bed. Nowadays, no less than 15 groups in different parts of the world are using this technique. The theory of different TAP-modifications is presented, in particular the theory of the thin-zone TAP-reactor which gives a possibility to reveal detailed mechanisms of complex catalytic reactions.

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