

# Adsorption phenomena in heterogeneous catalysis studied by adsorption microcalorimetry

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Adsorption phenomena play an important role in heterogeneous catalysis. The knowledge about heat of adsorption of reactant on the surface of a catalyst can contribute to a better understanding of the complex microkinetics. Moreover, the quantitative data provide a basis for theoretical modeling. Since perhaps only a minor fraction of all surface atoms form active centers, the determination of their number and strength requires a sensitive analytical method. Here, we focus on adsorption microcalorimetry [1]. To facilitate the correlation of microcalorimetric results with the catalytic performance, a molecule similar to the reactant, or the reactant itself, was used.  $T_{\text{ads}}$  was chosen lower than  $T_{\text{reaction}}$  to separate the adsorption process from the catalytic reactions or closely related to  $T_{\text{reaction}}$  to study the surface chemical events during reaction.

In this work, we will demonstrate how structure-activity correlations can be established by combining microcalorimetry with electron microscopy and spectroscopic techniques, like IR and XPS. The power of these complementary methods will be illustrated by choosing the following examples: (i) carbon-based catalysts (oCNT) for ODH of propane or ethylbenzene [2], (ii) supported metals (Pd/N-CNT) for liquid phase oxidation of benzyl alcohol [3], (iii) supported oxides (CeO<sub>2</sub>/support) for HCl oxidation [4], (iv) propene metathesis over MoOx/SBA-15 (Fig.1, Fig.2) [5], and (v) mixed metal oxides (MoVTenb oxide) for selective oxidation of propane to acrylic acid [6].

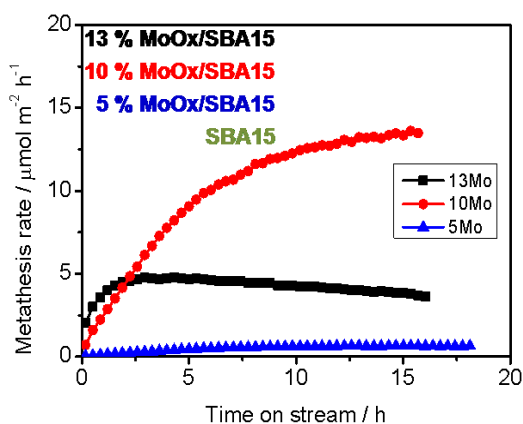


Fig. 1: Propene metathesis activity of MoOx/SBA-15 at 323 K. The catalyst was activated in a 20% O<sub>2</sub> flow at 823 K for 0.5 h.

→ Activity strongly depends on the Mo loading

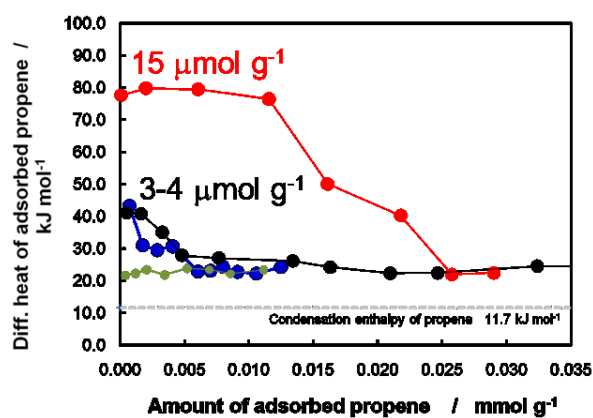


Fig.2: Differential heat of adsorption of propene determined by microcalorimetry at 323K on MoOx/SBA-15 and SBA-15 pretreated in O<sub>2</sub> at 823K and 20kPa for 0.5 h;

→ Correlation between amount and strength of propene adsorption sites and catalytic activity.

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