Hydroformylation - door opener to highly efficient tandem reactions to bifunctional molecules
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Abstract
Hydroformylation is one of the best known and widely applied homogenously catalyzed reactions yielding aldehydes from olefins. After Roelen reported the hydroformylation in 1938 for the first time with cobalt complexes, catalyst systems were developed to highly tailor-made Rhodium catalyst e.g. in the Ruhrchemie/Rhône-Poulenc Process (Scheme 1).

Scheme 1: Hydroformylation of propene to yield butanal

Tandem reactions merge two or more reactions in one reaction vessel. Their major benefit compared with the stepwise synthesis of valuable molecules is not only to offer the possibility to save effort and time, which might be the main advantage for laboratory syntheses, but also resources in manifold manner. Saving resources, especially on an industrial scale, becomes increasingly important in times as struggle for sustainability is one of the major competitions of chemical production.

The hydroformylation bears the possible change to merge other reactions in one reaction vessel and leverage the potential of tandem reactions. One prominent example is the hydroaminomethylation which was discovered by change when amines were added to the hydroformylation.

Scheme 2: Hydroaminomethylation and other reactions

This contribution will present examples of tandem reactions consisting of hydroformylation as their first key step (Scheme 2). One example is the hydroaminomethylation of fatty esters with different amines to yield bifunctional products. Also a highly selective bis-hydroaminomethylation to yield \(\alpha,\omega\)-esters for polymer applications will be shown. Apart from the hydroaminomethylation newly developed tandem reactions catalysed by rhodium and organocatalysts e.g. hydroformylation/acyloin formation and hydroformylation/alkylation will be presented to show the advantages and drawbacks of the tandem concept and the strategy to develop new reaction patterns.