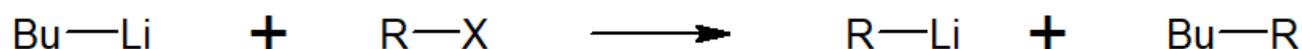


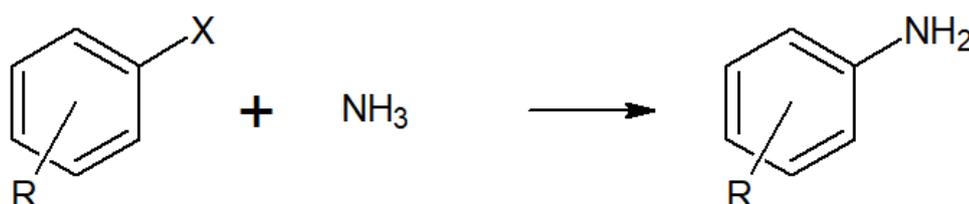
# Microinnova Chemistry Portfolio

Within Microinnova, we collected experience for a wide range of reactions, technologies and processes. A selection of these are shown in the following.

We worked with highly exothermic reactions, where exact temperature control within the reactor is critical, such as halo-lithium exchange reactions.

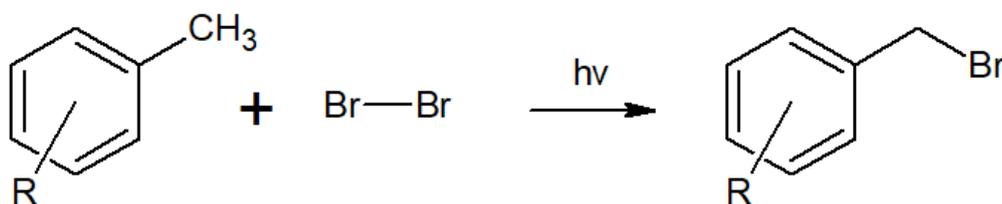


Commonly, high temperature and high pressure processes are investigated, in which reactions can be performed that would not occur under normal conditions, such as aromatic aminations.

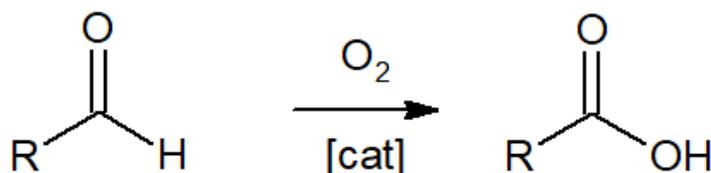
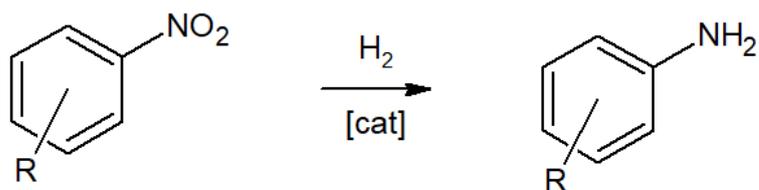


Processes with highly reactive or corrosive reagents, such as hydrofluoric acid were developed. A special approach is the usage of generators, in which those highly reactive or toxic species are formed in situ, before being directly consumed in the reactor. Examples therefor are chlorine, bromine, cyanogen bromide or diazomethane.

The photo-bromination of toluene derivatives was performed with in situ generated bromine on kg-scale.



Frequently, multiphase processes which demand perfect mixing over the whole reactor are developed. Catalytic hydrogenations using hydrogen and oxidations using oxygen were performed on heterogeneous catalysts in a solid-liquid-gaseous regime.



Some further examples for reactions performed within Microinnova are epoxidation reactions, esterifications, polymerisations, alkylation reactions, formation of heterocycles, Williamson ether synthesis and Wittig reactions.

We also have experience with processes that do not include a chemical reaction itself, such as, precipitation, formulation and emulsification. A special topic we worked on, is the emulsification by the usage of ultrasound.

## Chemical reactions - Application area examples

In the below-mentioned tables, you see an extract of our comprehensive project list regarding chemical reactions.

• alkylation (inorgani	• oxidation (primary alcohol)
• Blanc reaction	• polymerisation
• catalytic gas phase reaction	• precipitation
• comproportionation	• Prilezhaev epoxidation
• hydroxylation of oxirane	• Robinson annulations
• lithiation	• salt formation reaction (N-S, C-C bond formations)
• emulsification	• tetrazole synthesis
• esterification	• transesterification
• nucleophilic substitution (organic peroxides)	• Williamson ether synthesis
• Michael addition	• Wittig reaction