# From Microwave to Flow - Process Intensification Utilizing High-Temperature/Pressure Chemistry

C. Oliver Kappe
*Institute of Chemistry, University of Graz*
*Heinrichstrasse 28, A-8010 Graz, Austria*
oliver.kappe@uni-graz.at

The use of micro- and mesofluidic reactors has opened up new horizons for synthetic organic chemistry and the chemical manufacturing industry. Traditionally, most synthetic transformations performed in microreactors have involved ambient or even low-temperature conditions in order to safely conduct highly exothermic reactions. More recently, processes at elevated temperature conditions in pressurized microreaction devices (and related continuous flow reactors) have been reported, although the number of publications describing synthetically valuable transformations in a genuine high-temperature and high-pressure (>200°C/>50 bar) flow regime is rather limited. Process intensification philosophies, such as the exploration of novel process windows at exceptionally high temperatures and pressures are made possible with this technology and result in a majority of reactions being completed within only a few minutes of residence time.

This high-temperature microreactor approach can also be used to overcome the scale-up limitations inherent to high-speed microwave batch processing in sealed vessels. Vice versa, microwave reactors can be used for rapid method development, since the reaction time at a certain temperature obtained in a microwave reactor can be directly translated to a residence time in a flow reactor.

In this lecture the execution of a number of synthetically valuable organic transformations in a high-temperature/high-pressure continuous flow format will be described, including monophasic and multiphasic (liquid/liquid, gas/liquid) processing conditions. Chemistry examples include the formation of heterocycles, homogeneous, heterogeneous and flow nanocatalysis, and several reduction and oxidation processes that can safely be conducted in a continuous flow environment.