

From Monolith to e-Reactor - a Long Journey with Many Meanders

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It was expected that after successful application of monolithic converters for vehicle emissions control in the next step this reactor type will be broadly applied also in chemical syntheses. The possibilities to eliminate mass transport limitations and a low pressure drop have been praised. These expectations have not been fulfilled, i.e. only a few industrial applications have been realized. The reasons for that will be discussed by presenting two industrial developments, i.e. monoliths for gas and liquid phase hydrogenations.

The next decades brought dynamic development of the micro-reaction technology. The idea of the structured catalyst integrated into reactor design experienced revival. Several designs of micro-structured catalytic reactors have been proposed. In difference to the monoliths these designs aimed at control of strongly exothermic reactions by means of effective heat removal. Especially, integration of exothermic and endothermic reactions in one reactor has been seen as a novel, very promising concept. Several reaction systems have been tested in the laboratory scale micro-catalytic reactors and even one demonstration-scale unit has been constructed. However, micro(mili)-catalytic wall reactors exhibited also a number of disadvantages. Based on these experiences a micro-structured multi-stage adiabatic reactor has been proposed and studied. A selected example, i.e. catalytic oxidation reaction will illustrate advantages of this solution. This concept is also very well suited for the integration of exo- and endo-thermic reactions.

Many of the above described developments were driven by the need to convert alternative resources, to feedstocks for chemical industry. In the current decade the situation changed, i.e. crude oil shortage is no more an issue. However, the strong trend to deploy alternative sources for renewable energy brought other challenges and opportunities. For example chemical transformations could be used to deal with the fluctuating supply of the renewable electrical energy. As a technical solution an e-reactor has been developed. This design utilizes know-how collected with operation of monolith and catalytic micro- and milli-reactors.

In the paper a short review of the above developments will be presented.