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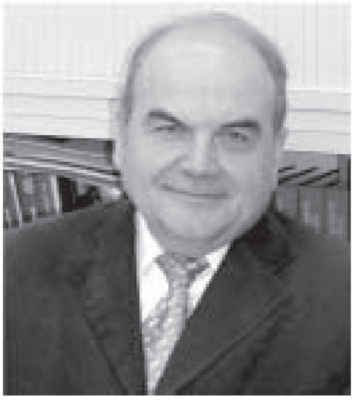
EDITORIAL

Microstructured Reactor Systems



Microreaction Technology in Chemical Reaction Engineering has experienced a spectacular development in the recent past. In Europe the development started mainly with a workshop on 'Microsystem technology for chemical and biological microreactors' held in Mainz, Germany in 1995. This first workshop was followed by six 'International Conferences on Microreaction Technology' (IMRET) organized up-to-now alternately in Europe and North America. The seventh International Conference on Microreaction Technology will be held in Lausanne in September 2003. As a consequence of the rather new and rapidly growing developments, most of the literature in the domain of microtechnology can be found in the proceedings of these international conferences.

Microstructured reactors are characterized by three-dimensional structures in the sub-millimeter range. Mainly multichannel reactors are currently used with channel diameters between ten and several hundred micrometers. Therefore, one of the main features of microstructured reactors is their high surface to volume ratio compared to traditional chemical reactors. The specific surface in microchannels is in the range of 10000–50000 m^2/m^3, whereas the specific surface in typical laboratory and production vessels is about 100 m^2/m^3 and seldom exceeds 1000 m^2/m^3. In addition, heat transfer coefficients are about one order of magnitude higher compared to traditional heat exchangers.

The high heat transfer performance allows very fast heating and cooling of reaction mixtures in open reactor systems. Consequently, reactions can be carried out under isothermal conditions for short, well-defined residence times in the reactor, and the decomposition of unstable products can be efficiently avoided.

Due to the small reactor dimensions diffusion times are short and the influence of mass transfer on the rate of reaction can be efficiently reduced. As the heat transfer performance is greatly improved compared to conventional systems, higher reaction temperatures are admissible leading to reduced reaction volumes and amounts of catalysts. Therefore, microstructured reactors are especially predestinated for fast, highly exothermic or endothermic chemical reactions.

The small inventory of reactants and products leads to an increased inherent safety of the reactor. In addition, it was demonstrated that the reactor can be operated safely under conditions in the explosion regime. The small reactor dimensions facilitate the use of distributed production units at the place of consumption thus avoiding the transportation and storage of dangerous materials.

The potential benefits of microstructured reactors can be summarized as follows:

- Process intensification
- Inherent reactor safety
- Broader reaction conditions including the explosion regimes
- Distributed production
- Faster process development

In the present special issue of CHIMIA we have tried to cover different aspects in the use of microstructured reactors. Besides the design and construction methods of microstructured reactors their use in screening and development of heterogeneous and homogeneous catalysts is presented. The advantages of microreaction technology for gas/solid and gas/liquid systems is demonstrated in two further contributions. Finally microreaction technology is introduced as a versatile tool for the development of new methods in chemical synthesis and the small scale production in the fine chemistry and pharmaceutical industries.

I would like to thank all contributors to this issue for their cooperation and hope that their reviews will stimulate the reader to consider microreaction technology as a valuable tool in chemical research and development.

Prof. Dr. Albert Renken
Laboratoire de génie de la réaction chimique
Faculté des sciences de base
Ecole polytechnique fédérale de Lausanne
LGRC-SB-EPFL
CH-1015 Lausanne

With great pleasure the Editorial Board of CHIMIA warmly thanks the coordinating guest editor Prof. Albert Renken acknowledging his efforts in planning and efficient collation of the present most attractive variety of contributions on 'Microstructured Reactor Systems'.