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EDITORIAL

Homogeneous and heterogeneous catalysis in industry

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Catalysis enables the chemical industry in all its forms, from refineries to pharmaceuticals, from fossil fuels to biomass and it is regularly stated that over 90% of all chemical products have at least one catalytic step in their manufacture. The research that underpins industrial catalysis is equally ubiquitous. From a single PhD student to the might of an industrial R&D laboratory, all can contribute to the journey that takes a catalytic process from basic idea through to full plant realisation. In this special issue on 'Homogeneous and heterogeneous catalysis in industry' we report on all aspects of catalysis that are either directly aimed at the development of an industrial process or that can be seen as enabling for such a process. Not surprisingly most of the former ones are from industry whereas most of the latter articles stem from academia. Although the basic reaction is often well known, extensive research is usually needed in order to improve the rate or the (enantio-)selectivity. It is this research that moves the process from laboratory to plant. Various aspects can be discerned. Very often a first phase is screening of catalysts, and for fine chemicals this is sometimes all that is needed. However, finding a catalyst that provides the desired product in good selectivity is very often at the beginning of a long journey. Particularly for bulk processes but often also for fine chemicals the cost of the catalyst needs to be reduced for an economic process. Indeed, increasing the turnover numbers for a given process is often the major focus of industrial catalysis research. There are many ways in which this can be achieved. A first attempt will often be aimed at increasing the rate of the catalyst by changing the solid support, the ligand or simply reaction conditions. Less well-publicised are attempts to investigate the origins of catalyst deactivation. Yet, this line of research can be highly rewarding and lead to processes with astonishing turnover numbers.

Another important area of research is the integration of catalysis and engineering to create the optimal process. Whereas this is standard in research for bulk chemicals, for fine chemicals this is a relatively new aspect. Worth mentioning in this respect is the use of flow reactors, particularly for highly exothermic reactions or for reactions using highly toxic chemicals.

Catalysis has always been an important tool for creating more sustainable processes. More recently, we see the important part catalysis plays in the conversion of biomass into fuels and chemistry. The interest in chemicals based on renewable resources is rapidly rising throughout the entire chemical industry and the first plants are starting up as we speak.

In this special issue, with advances in modelling, biomass utilisation and ligand design in processes that span high-temperature high-pressure high-tonnage to small-scale ambient-pressure liquid-phase, we see the breadth and depth of catalysis development needed to deliver the next generation of catalytic processes. We thank all contributors for helping to create such a clear picture.

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