Preface

The increasing cost of fossil fuels and the concerns related to their environmental impact and greenhouse gas effect, as well as the need of securing energy supplies, are accelerating the transition to a bio-based economy. Various R&D tools need to be provided to realize this transition. The replacement of fossil fuel by bio-mass has been addressed in recent years worldwide. The EU, for example, has defined a target to double the share of renewable energy from 6% in 1997 to 12% by 2010 (COM 1997 599).

The use of renewable resources in manufacturing chemicals and other products, such as oils from oilseed crops, starch from cereals and potatoes and cellulose from straw and wood, is also receiving increasing attention from policy makers. Further transformation of these products leads to polymers, lubricants, solvents, surfactants and specialty chemicals for which fossil fuels have traditionally been used. However, it is necessary to extend the use of biomasses for chemical production and integrate them in the energy business to create a sustainable society. The concept of the biorefinery, initially developed in the food and paper industries, is now being applied to integrate biomass-based energy, materials and chemicals production. A biorefinery maximizes the value derived from the complex biomass feedstock by producing multiple products. Integrated production of bioproducts, especially for bulk chemicals, biofuels, biolubricants and polymers, can improve their competitiveness and eco-efficiency. Also in this case, new R&D tools should be developed to address this change with respect to oil-based energy, material and chemical economy.

Many benefits for EU industry, consumers and the environment derive from the use of renewable raw materials: (a) increased competitiveness from products having tailor-made performance compared with, or in combination with, conventional materials; (b) a more stable and secure source of supply; (c) a reduction in environmental impact; (d) new and growing markets, providing economic benefits to industry as well as; and (e) employment opportunities in processing industries and the agricultural sector.

Many improvements are still needed to make really effective use of renewable raw materials in biorefineries. Full utilization of the plants is needed instead of the current under utilization, as well as the development of processes to add value to all fractions of the plant and to valorize the by-products of other industrial

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systems (e.g., black liquor in the wood/paper industry, glycerol from biodiesel, whey from cheese production, etc), downstream processing strategies (low cost recovery and purification), development of closed-cycle sustainable systems, etc.

Catalysis is a core technology of the current fossil fuel based economy. Over 90% of industrial chemical processes involve catalytic steps and, also, several processes in current refineries are catalytic ones. Without continuous progress and innovation in catalysis, the current pervasive oil-based economy is not possible. Similarly, catalysis technology will also have a key role in the transition to a bio-based economy. The possibility of realizing this transition and to develop effective bio-refineries will depend on the progress made in developing new catalytic processes and concepts.

Hence, catalysis may be considered as an enabling technology for this transition and, for this reason, it is necessary to better understand the limitations and possibilities in this field. We need to define future necessary directions of R&D and the needs of fundamental and applied knowledge. In other words, there is the need to develop a roadmap for catalytic processes based on renewable feedstock. This book aims to provide an overview of the current state-of-the-art on which such a research agenda can be based.

This book originates from the workshop ''Catalysis for Renewables'', which was dedicated to this issue and held in Rolduc (Kerkrade, The Netherlands) on May 16–18th, 2006. The objective of the workshop was to provide strategic input to catalytic process options for the conversion of renewable feedstock into energy and chemicals. It was a brainstorming meeting aimed at defining new directions and opportunities for catalytic research in this field by integrating industrial, governmental and academic points of view. The different chapters in this book cover the various aspects reviewed during the workshop, while the concluding chapter provides a critical synthesis of the active discussion held during the workshop, with the aim of defining a Research Strategic Agenda in catalysis for renewables.

The workshop was organized by the NRSC-Catalysis (National Research School Combination Catalysis) of The Netherlands within the framework of the activities of the EU Network of Excellence (NoE) IDECAT (Integrated Design of Catalytic Nanomaterials for a Sustainable Production).

The objective of this NoE is to strengthen research in catalysis by the creation of a coherent framework of research, know-how and training between the various disciplinary catalysis communities (heterogeneous, homogeneous, and biocatalysis) with the objective of achieving a lasting integration between the main European Institutions in this area. IDECAT will create the virtual ''European Research Institute on Catalysis'' (ERIC) that is intended to be the main reference point for catalysis in Europe.

IDECAT focuses its research on (a) the synthesis and mastering of nano-objects, the materials of the future for catalysis, also integrating the concepts common to other nanotechnologies; (b) bridging the gap between theory and modeling, surface science, and kinetic/applied catalysis as well as between heterogeneous, homogeneous and biocatalytic approaches; and (c) developing an integrated design of catalytic nanomaterials.

Objectives of IDECAT are to:

1. create a critical mass of expertise going beyond collaboration;
2. create a strong cultural thematic identity on nano-tech based catalysts;
3. increase the cost-effectiveness of European research;
4. establish a frontier research portfolio able to promote innovation in catalysis use, especially at the SMEs level;
5. increase potential for training and education in multidisciplinary approaches to nano-tech based catalysis; and
6. spread excellence beyond the NoE to both the scientific community and to the citizen.

Next-generation catalysts should achieve zero-waste emissions and use selectively the energy in chemical reactions. They will also enable the development of new bio-mimicking catalytic transformations, new clean energy sources and chemical storage methods, utilization of new and/or renewable raw materials and reuse the waste, solving global issues (greenhouse gas emissions, water and air quality) and realizing smart devices. These challenging objectives can be reached only through a synergic interaction between the best catalytic research centers and in permanent and strong interaction with companies and public institutions. This is the scope of IDECAT.

In conclusion, this book constitutes the first step of IDECAT in developing a coherent framework of activities to create a bio-based and sustainable society through catalysis. This book is at the same time an updated overview of the state-of-the-art and a roadmap that defines new directions, opportunities and needs for R&D. Finally, we warmly thank Dr. Ad Kolen, NRSC-Catalysis (The Netherlands), whose continued support made possible both the workshop cited and this book.

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