ENGINEERING OF CHEMICAL COMPLEXITY

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**World Scientific Lecture Notes
in Complex Systems – Vol. 11**

editors

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Gerhard Ertl**

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PREFACE

How to engineer chemical systems whose operation is self-organized? This question becomes topical in the light of an impressive progress in understanding of complex chemical systems of inorganic and biological origins. The gained knowledge makes it already possible to proceed to the next stage where not only the purposeful control of such natural systems, but also the attempts to design their synthetic counterparts can be made. The phenomenon of life, emerged as a product of a specific biological evolution, may thus be transferred to a broad range of artificial systems which are designed for particular applications. In the long perspective, this would revolutionize the technology, moving it from the present form, essentially based on the mechanistic concepts of the 19th century, to the functional organization characteristic for living beings. Early indications of the approaching transition can be seen in the current research on the design of genetic networks, on the development of artificial or synthetic living cells, and on the construction and manipulation of single-molecule protein machines.

This book provides a survey of the current state of the art in the analysis, design and control of complex chemical systems. It is based on the plenary and selected invited talks given at the international conference “Engineering of Chemical Complexity” which had taken place in the summer of 2011 and was hosted by the newly established Berlin Center for Studies of Complex Chemical Systems. The book includes such topics as the manipulation and steering of single molecules and molecular motors, design of the systems based on active soft matter, control of collective dynamics and synchronization behavior, synthetic biology and the development of protocells.

While organizing the conference and preparing this publication, we have relied on the assistance by Ingeborg Reinhardt, Ulrike Christine Künkel and Rico Buchholz; we would like to express our sincere gratitude to all of them. We are pleased to acknowledge generous financial support provided for the conference from the German Research Foundation (DFG), from the Collaborative Research Center (SFB 910) “Control of Self-organizing Nonlinear Systems”, the Training Research Group (GRK 1558) “Nonequilibrium Collective Dynamics in Condensed Matter and Biological Systems”, and from the Solvay Company.

Alexander S. Mikhailov and Gerhard Ertl
Berlin, April 2012

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