Preface

The Beilstein Symposia address contemporary issues in the chemical and related sciences by employing an interdisciplinary approach. Scientists from a wide range of areas – often outside chemistry – are invited to present aspects of their work for discussion with the aim of not only advancing science, but also, furthering interdisciplinary communication.

Feynman's engaging title for his 1959 lecture, "There's plenty of room at the bottom" is as valid now as it was when he gave it. He presented a vision of a scientific world beyond a few billionths of a meter that was at that time far away of any technological feasibilities and applications. However, it opened the minds towards the creation of new scientific disciplines that are now called nanoscience and nanotechnology. The "nano" prefix not only refers to the extremely small but also stands for the integration of traditional physics, chemistry, biology and engineering disciplines to form an interdisciplinary science which has far-reaching consequences for science, the environment and society.

Scientific research is about gaining knowledge of a system, which technology can then use for developing practical applications. In the nanoscale dimension, there are unrivalled possibilities for the development of functional objects and techniques in areas ranging from nanoelectronics, nanoscale sensors and novel data storage devices to novel materials and coatings, cosmetics, fuel cells, catalysts, to pharmaceuticals and medical implants. The properties and phenomena that these objects exhibit occur precisely because they are extremely small, existing in an environment where the laws of physics operate in unfamiliar ways. Today, the full ramifications of many experimental achievements are not always apparent and how many of these will result in applications in the future is unclear – the potential is perhaps only limited by our own imagination.

One of the main challenges of nanoscience and technology over the next decades is to achieve precise positional control of material at the nanoscale allowing, for example, the fabrication and manipulation of single molecules. Top-down approaches, such as lithography or bottom-up, as in biological systems, combined with imaging and manipulation techniques such as STM and optical tweezers are providing scientists with insights into the behavior and control of matter at the nanoscale.

In nature, we find complex, highly efficient and highly optimized systems such as biological cells which demonstrate how matter and energy can be controlled on the nanoscale. A higher degree of understanding of how biological systems are organized and function will not only increase our knowledge of living things but will find applications in other branches of nanoscience. This will not only enhance our ability to manufacture functional materials, but also holds promise to find solutions to more general problems in, for example, the areas of energy and health.

This symposium on Functional Nanoscience brought together experts in the field to present and discuss new results and approaches including the following aspects of nanoscience and nanotechnology, i. e. self-organization and self-assembly, molecular motors and transport, self-replicating biomimetic systems, quantum effects, molecular magnets, imaging and manipulation of molecules at the atomic scale / single molecule reactions.

We would like to thank particularly the authors who provided us with written versions of the papers that they presented. Special thanks go to all those involved with the preparation and organization of the symposium, to the chairmen who piloted us successfully through the sessions and to the speakers and participants for their contribution in making this symposium a success.

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Martin G. Hicks
Carsten Kettner

Cover Image, courtesy of Michael Huth, University of Frankfurt/Main

Scanning electron microscopy image of a Pt-C composite structure created by focused electron beam induced deposition (FEBID) using trimethyl-Pt-cyclopentadienyl-methyl as precursor gas. The deposit resulted from a repeated electron beam raster process with 10 nm pitch and 100 micro-seconds dwell time on each point colored in black of a black-and-white bitmap defining the target image. The electron beam parameters were 5 kV at 1.6 nA beam current. Si (100) with 300 nm thermally grown SiO_2 was used as substrate material.