

150 Years of BASF

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150 years of BASF—this is indeed a unique anniversary we celebrate in 2015, and we want to commemorate this milestone with some outstanding experiences.

We will of course look back at our long history and celebrate our achievements since 1865, when the ambitious entrepreneur, Friedrich Engelhorn, founded the company. He drove the production of dyes based on coal tar and bundled the whole value chain and the respective production processes in one company. Since then, BASF's Verbund (network) of people, production and technology remains one of the company's key strengths and the Badische Anilin- & Sodafabrik has become the leading company in the chemical industry worldwide.

Our success formula has always remained the same: we use our creativity and scientific competence together with our network of partners to develop solutions for people's needs. We will continue to build upon this. In our anniversary year, we want to look into the future and discuss how we can secure limited resources for a rapidly growing global population, and thus give more people access to a higher quality of life.

To this end, we will tackle important societal questions in the fields of energy, food, and urban living. Where does the energy that we need come from? How will we provide enough food and clean water for so many people? What will the cities of the future look like? We want to contribute to answering these, and many

more questions, with you, with our partners from science, industry, politics, and society, and with everyone who is interested.

Together with the scientific community, we want to get a better understanding of the anniversary themes by hosting three global symposia: More than 1 500 scientists and 100 speakers from various research institutions will meet in Ludwigshafen, Chicago, and Shanghai to discuss the topics of energy, food, and urban living. In this issue of *Angewandte Chemie*, we have invited some of the speakers from these symposia to share their ideas and visions of the role chemical research has in finding solutions to global challenges.

Smart Energy

At the current rates of population growth and increasing industrialization, the demand for electricity is expected to rise to 32 000 TWh by 2035. By 2050, the global energy demand will double or even triple. Energy—from transformation to storage and use—is taken for granted in industrial countries. How can we satisfy our future energy needs in a way that is affordable, reliable, and environmentally sound? In this issue, the reader will meet various research approaches across the energy value chain of the future from basic research all the way to application.

The first topic is a research field that is directly related to the origins of BASF. Based on important examples from the chemical industry, **Robert Schlögl** pres-



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ents the dynamic nature of catalysts. Understanding these mechanisms could be the key to managing the necessary change in the raw material base of the chemical industry and integrating renewable energy sources into our energy mix. **Ferdi Schüth** discusses how to drive the co-development of catalyst and reactor, adapt reaction conditions, and integrate the components into the overall production process as the basis for catalysts with excellent selectivity.

Intelligent storage of energy and fuels is of outstanding importance. The field of metal-organic frameworks (MOFs) has developed over the last 15 years such that thousands of new structures can be utilized in applications related to energy, the environment, electronics, and biomedicals. **Omar Yaghi** goes into the question of how to introduce heterogeneity in MOFs while retaining their ordered, crystalline structures. **Linda Nazar** summarizes latest developments in sodium-ion batteries and their relevance for sustainable and affordable electrochemical energy storage. In addition, she highlights the importance of computational methods in materials research for a better understanding of, for example, ion mobility. How society will use its limited resources to sustainably satisfy increased demand for fuels and chemical products is also addressed by **Peidong Yang** in his contribution on artificial photosynthesis. One of the main focus areas in photovoltaic research are organic-inorganic perovskites, which have achieved efficiencies in the laboratory that are similar to thin-film photovoltaic technologies. **Henry Snaith** presents the various methods of

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creating perovskite films as well as their material properties.

Food

By the year 2050, farmers will be expected to double the current rate of food production because of population growth. This challenge is further compounded by the growing need for higher food quality and improved nutrition. How can we sustainably produce more high-quality food?

Advances in basic research will drive innovative answers to these questions. Organic synthesis, protein, and structural biology, as well as industrial biotechnology are all examples of research fields which will contribute to progress. **Steven Ley** envisages automation to revolutionize organic synthesis in the future. He describes how multidisciplinary approaches, computerization and visualization, downstream processing such as “in-line” evaporation and filtration, and analytical tools such as Raman spectroscopy, will open up new opportunities to take a more holistic and efficient approach to chemistry. **Frances Arnold** highlights how significant advancements in protein design can be expected in the future. As we learn from nature and transfer evolutionary mechanisms to the lab, we will be able to develop novel tailor-made biocatalysts. This will increasingly allow the potential of biocatalysis to be utilized in chemical synthesis.

Christoph Wittmann explains how tomorrow’s biotechnology will combine system biology with the tools of genetic modification to develop microorganisms suitable for the production of natural products. From cell to cell factory is the leitmotif for the bio-based production of novel and commercially important chemicals, materials, fuels, and active ingredients.

Tobias Ritter explores the importance of new fluorination methods, which can be used to optimize active ingredients and synthesize biological probes. The Review by **Michael Krische** describes new catalytic reactions through which simple building blocks, like methanol or

formaldehyde, can be used to synthesize complex bioactive molecules. Molecular recognition in chemical and biological systems is in many cases still not completely understood, in particular the role of water molecules in aqueous systems. **François Diederich** discusses the latest insights into noncovalent molecular interactions and illustrates them with recent examples.

Urban Living

This topic tackles the question of how can more people live better lives in urban areas in the future? How can we improve water management, mobility, buildings, and quality of life in general? How can we bring together all the relevant disciplines and representatives from science and industry to achieve intelligent and affordable solutions for mobility, construction, and water? Tony Fane, Kookheon Char, and Tadahisa Iwata address important aspects of the sustainability debate from the perspective of chemical research: water, waste, and recycling. Innovative materials and new processes to produce drinking water from seawater or wastewater are indispensable to meet the ever-growing lack of drinking water. **Tony Fane** combines material science, device design, and membrane engineering to create synergies and enable improved solutions. From waste material to feedstock: **Kookheon Char** follows the need for new energy storage systems. He analyzes how the increasing amounts of elemental sulfur obtained by the oil and gas industry can be used, and summarizes new physical and chemical methods to directly process elemental sulfur in materials for batteries and optical applications. **Tadahisa Iwata** analyzes the growing demand for sustainable plastics and offers a classification of next-generation bio-based and biodegradable plastics.

By learning from nature, **Jiang Lei** explores routes to superwettability and explains how novel functional systems can be generated by combining different materials and surface structures. These systems could be used for controlling cell adhesion, for phase separation, and for robust surfaces in domestic as well as

in industrial applications. **André Studart** illustrates how interactive and adaptive properties can be designed in dynamical materials systems by mimicking hierarchical biological structures.

The creative force of chemistry in shaping the future is laid out by **Jean-Marie Lehn**. In the context of dynamic molecular assemblies, he describes how bringing together molecular and supramolecular chemistry can help develop new materials by self-organization and selection processes. Some of these materials respond to external stimuli, thereby addressing applications in classical material technology as well as in the life sciences.

George Whitesides concludes that chemistry will need to reinvent itself in order to realize the change from molecules to systems and help solve the increasingly multidisciplinary tasks in intelligent energy, food, and urban living as well as many other challenges of the 21st century.

Generate New Ideas Together

This exchange and dialogue will certainly extend well beyond the world of science. With our anniversary program we break new ground to facilitate an extensive engagement on the above-mentioned topics. We call it Creator Space™. It includes key elements such as scientific symposia, events, and co-creation activities with customers and interested partners, in addition to the website Creator Space™ online. With this website, we aim at unlocking a global, internet-based community. We are convinced that the contributions of diverse people worldwide will be an important key to success.

The global challenges, and the solutions that we will require for these, are becoming increasingly complex. Interdisciplinary, diverse, worldwide cooperation will be required in order to generate new ideas. Working together in this way has a long tradition at BASF.

With our program, we create the framework to encourage spontaneous contributions, creative ideas, and look



beyond the obvious. We are convinced that co-creation activities with our customers, employees and scientists will result in new inno-

vative approaches. We will pursue certain promising concepts beyond our anniversary year and we invite all readers to participate in this dialogue. Think with us and talk to us on our interactive anniversary platform www.creator-space.basf.com.

We thank all authors and those who have already started to enrich discussions in the anniversary year, both online and in person, with ideas and comments. We are looking forward to your suggestions and are excited about the result of this big experiment in the 150th year of our BASF.