

Preface

The idea of publishing books based on contributions given by emerging young chemists arose during the preparation of the first EuCheMs (European Association for Chemical and Molecular Sciences) Conference in Budapest. In this conference I cochaired the competition for the first European Young Chemist Award aimed at showcasing and recognizing the excellent research being carried out by young scientists working in the field of chemical sciences. I then proposed to collect in a book the best contributions from researchers competing for the Award.

This was further encouraged by EuCheMs, SCI (Italian Chemical Society), RSC (Royal Society of Chemistry), GDCh (Gesellschaft Deutscher Chemiker), and Wiley-VCH and brought out in the book "Tomorrow's Chemistry Today" edited by myself and published by Wiley-VCH.

The motivation gained by the organization from the above initiatives was, to me, the trampoline for co-organizing the second edition of the award during the second EuCheMs Conference in Torino. Under the patronage of EuCheMs, SCI, RSC, GDCh, the Consiglio Nazionale dei Chimici (CNC), and the European Young Chemists Network (EYCN), the European Young Chemist Award 2008 was again funded by the Italian Chemical Society.

In Torino, once again, I personally learned a lot and received important inputs from the participants about how this event can serve as a source of new ideas and innovations for the research work of many scientists. This is also related to the fact that the areas of interest for the applicants cover many of the frontier issues of chemistry and molecular sciences (see also *Chem. Eur. J.* 2008, **14**, 11252–11256). But, more importantly, I was left with the increasing feeling that our future needs of new concepts and new technologies should be largely in the hands of the new scientific generation of chemists.

In Torino, we received about 90 applications from scientists (22 to 35 years old) from 30 different countries all around the world (*Chem. Eur. J.* 2008, **14**, 11252–11256).

Most of the applicants were from Spain, Italy, and Germany (about 15 from each of these countries). United Kingdom, Japan, Australia, United States, Brazil, Morocco, Vietnam, as well as Macedonia, Rumania, Slovenia, Russia, Ukraine, and most of the other European countries were also represented. In terms of applicants, 63% were male and about 35% were PhD students; the number of

postdoctoral researchers was only a small percentage, and only a couple of them came from industry. Among the oldest participants, mainly born between 1974 and 1975, several were associate professors or researchers at Universities or Research Institutes and others are lecturers, assistant professors, or research assistants.

The scientific standing of the applicants was undoubtedly very high and many of them made important contributions to the various symposia of the 2nd EuChemS Congress. A few figures help to substantiate this point. The, let me say, "*h* index" of the competitors was 20, in the sense that more than 20 applicants coauthored more than 20 publications. Some patents were also presented. Five participants had more than 35 publications, and, *h* indexes, average number of citations per publication, and number of citations, were as high as 16, 35.6, and 549, respectively. Several of the papers achieved further recognition as they were quoted in the reference lists of the young chemists who were featured on the covers of top journals. The publication lists of most applicants proudly noted the appearance of their work in the leading general chemistry journals such as *Science*, *Nature*, *Angewandte Chemie*, *Journal of the American Chemical Society*, or the best niche journals of organic, inorganic, organometallic, physical, analytical, environmental, and medicinal chemistry.

All of this supported the idea of publishing a second book with the contributions of these talented chemists.

However, in order to have more homogeneous publications and in connection to the great number of interesting papers presented during the competition, we decided to publish three volumes.

This volume represents indeed one of the three edited by inviting a selection of young researchers who participated in the European Young Chemist Award 2008. The other two volumes concern the two different areas of synthetic chemistry and nanotechnology/materials-science and are, respectively, entitled "Ideas in Chemistry and Molecular Science: Advances in Synthetic Chemistry" and "Ideas in Chemistry and Molecular Sciences: Advances in Nanotechnology, Materials, and Devices".

It is important to mention that the contents of the books are a result of the work carried out in several topmost laboratories around the world both by researchers who already lead their own group and by researchers who worked under a supervisor. I would like to take this occasion to acknowledge all the supervisors of the invited young researchers for their implicit or explicit support to this initiative that I hope could also serve to highlight the important results of their research groups.

The prospect of excellence of the authors was evident from the very effusive recommendation letters sent by top scientists supporting the applicants for the Award.

A flavor of these letters is given by the extracts from some of the sentences below:

"The candidate creativity in polymer design for therapeutic impact is extremely impressive. I believe that he is an excellent example of an outstanding young European chemist"; "Is an energetic, enthusiastic, articulate, bright researcher"; "Talented and enthusiastic scientist who has a lot of determination and persistence. I was impressed by the strong preparation, enthusiasm and motivation. First rate

researcher"; "...outstanding, very broad and far reaching research achievements"; "The personality and the scientific research achievements will certainly pave the way as a future leader of an independent and creative research group. Due to his original and uncommon approach together with the high quality of results, he will become well known in the field of medicinal chemistry. All this exciting work relied on his ability as a chemist and on his bright intellect, which allows him to move across disciplines seamlessly"; "The candidate is a very articulate, knowledgeable, driven, clear minded, and extremely personable young scientist"; "Application in this work has been outstanding, strong, powerful and very dedicated. The candidate will be in a very good position to make tremendous impact in the area of therapeutics and to become a leader in the area of organic chemistry in the next generation"; "As one of the most talented graduate students to have emerged for our group he has the vision, skill and drive to make a real difference to the national research community"; "...outstanding young scientist and a charming person"; "...has an astonishing level of productivity"; "...work of very high caliber"; "Such deep and insightful investigations are refreshing and invigorating in my view especially in times that tend to favor simple, phenomenological results"; "The candidate has been the intellectual driver and forged the necessary collaborations to address this complex problem. He deft integration of the various experimental and theoretic disciplines needed for the work is impressive"; "The candidate performed outstanding research projects"; "He should be a compelling and deserving candidate of the European Young Chemist award"; "The candidate is for sure one of the most outstanding and promising young researchers that I know in the field of molecular science. Despite being young, he has a lot of experience and high motivation. He is excellent in the lab and extremely smart person"; "The candidate has performed work of top quality and originality and of great breadth"; "...a special individual who ranks among the very best"; "Exceptional in many respect. The candidate commands superior experimental and intellectual skills and has shown great chemical structure intuition in the project". "...outstanding scientific debater. The personality is impeccable". "Extremely gifted young researcher who has already developed an outstanding track record of achievement while working in one of the world's premier laboratories in the USA"; "Has the skills, expertise and leadership potential to discover new compounds that will revolutionize the therapy of some difficult diseases. The work is well-aligned to the University's strategy of supporting cross disciplinary research of the highest quality"; "...unusually broad dimension of experimental skills"; "This is a rare combination of expertise"; "enables to undertake a diverse scope of key problems. In my opinion these are the type of individuals who will drive the field forward"; "...has an engaging, outgoing, attractive personality to which others instinctively respond"; "Brilliant young chemist with a great potential".

The chapters written by the various contributors cover several areas of life science and range from more or less typical biochemical studies, to research relevant in the therapeutic field, to the enzyme or drug activity, to drug delivery, to computational structure-activity relation or sensors.

In the area of biochemical studies, the book collects a contribution in the field of inorganic chemistry of the brain with the chapter on the role of metal ions (Cu(II) in particular) and the ubiquitin–proteasome system on neurodegenerative disorder (Arnesano). In another chapter, the strategies for chemical modification of proteins as well as selective installation of biochemical probes and tethering of therapeutic cargo to proteins are highlighted (Bernardes *et al.*). Another chapter (Ribas *et al.*) is centered on Cu(III) ion and its bioinorganic and organometallic chemistry. In particular, this contribution turns out to be relevant for understanding copper-dependent metalloenzymes.

In the drug delivery domain, a chapter is dedicated to vitamin B₁₂ as potential targeting molecule for therapeutic drug delivery (Ruiz Sánchez). This potentiality is vividly illustrated by the author with the following definition: vitamin B₁₂ is an attractive “Trojan horse” for therapeutic drug delivery.

A second contribution starts from the consideration that the cellular membrane poses a formidable barrier to the intracellular flux of materials circulating extracellularly due to its selective permeability based predominantly on ionic charge, hydrophobicity, and size. As such, many drugs, nucleic acids, proteins, and other investigative constructs are not able to translocate the cellular membrane alone and often require a delivery vehicle for function and/or activity. After considering various vehicles this contribution focuses on a highly competitive cellular delivery technology based on polymeric microspheres-mediated cellular delivery (Sanchez-Martin). In particular, the author presents different strategies that can be applied for the attachment of biomolecules to the microspheres and their applications as a delivery system. Monodispersed populations of robust cross-linked microspheres of defined sizes (from 200 nm to 2 μ m) have been synthesized and standard solid phase multistep protocols have been applied to them.

Several contributions are primarily dedicated to research that has relevance to the therapeutic field.

The chapter (Lucio *et al.*) on molecular mechanisms, underlying therapeutic and toxic effects of drugs, highlights the importance of membrane composition and the dynamic molecular organization of membranes in drug–membrane interaction. Also, the work aims to exemplify an application of drug–membrane interaction studies in the evaluation of the nonsteroidal anti-inflammatory drug effect on membranes. These studies may prove valuable in the design of novel drug formulations with increasing efficacy and reduced side effects.

A second contribution in the area deals with targeting diseases with small molecule inhibitors of protein–protein interactions (Tavassoli *et al.*). The chapter starts from the consideration that there are several thousand protein–protein interactions that control the majority of biological processes. There is therefore great potential for small molecule therapeutics that affect disease through modulation of protein–protein interactions. In this chapter, there is then a discussion on recent approaches taken toward controlling protein interactions with small molecules, from logical design using structural data to high-throughput screening of chemical and biological libraries. The authors go on to outline their own efforts in this

field, and end with a detailed discussion of some of the important protein–protein interactions currently being targeted.

Another chapter (Hirsh) is dedicated to the design and synthesis of inhibitors of the kinase IspE as potential antimalarials opening a number of research avenues summarized in the chapter itself, while another contribution (Hillringhaus) deals with recent developments in glicomics – a technology that can be anticipated that it will strongly influence tomorrow's therapy in the areas of various diseases.

A last contribution (Bald) in this area deals with the important studies on the electron-induced modification of biomolecules, which may have potential implications for the design of new chemotherapeutic and radiosensitizing drugs and for the development of more efficient protocols in cancer therapy.

Understanding how nature works in the area of enzyme chemistry is the goal of a chapter (Company) dedicated to the tyrosinase reactivity. In this chapter, in particular, it is shown how the model chemistry approach has allowed to reproduce and to better understand the mechanisms by which O_2 is activated in the dinuclear copper protein just called *tyrosinase*.

The studies summarized in another chapter (Ricci) refer to electrochemical biosensors, termed *E-DNA sensors*, that are based on the target binding–induced folding of electrode-bound DNA probes and gives contribution on E-DNA signaling mechanisms. In addition, studies on E-DNA sensors for DNA binding protein detection are also reported. The E-DNA sensing platform has then demonstrated to be not only a promising and appealing approach for the sequence-specific detection of DNA and RNA but also to be flexible enough to be adaptable for the detection of DNA–protein interaction.

Taking into account that chirality selection is a key issue in many important biochemical phenomena such as protein folding and enzyme recognition, another chapter discusses the role of chirality in the chemistry of the life sciences. In particular, a novel methodology for the study of local chirality is presented, which provides one with a deeper understanding of the connection between secondary structure and protein flexibility. This computational study for investigating biomolecule conformation reported in the chapter (Pietropaolo) suggests that chirality is a central organizing principle in life that confers order at every length scale up to the full cell.

Probably, everyone who reads this book will have their own opinion on what is relevant for the future of life chemistry, and in this respect I would like to notify that, due to its peculiar genesis, the book reflects the opinions of a select group of young chemists and therefore does not pretend to cover the whole area.

The main aim is just to offer a variety of individual views that will provoke thought possibly giving an attractive insight into the minds and research areas for the next generation of chemical and molecular sciences, especially those related with life sciences and technologies.

Starting from this point, I hope that the many ideas that can be grasped sailing through the various contributions by the young authors of the book should be very useful for helping to make several step forward in the field of chemistry and molecular sciences to solve problems related to our health or more generally to our

life as well as to discover new tools in medicinal chemistry needed for the present and the future society.

I cannot end this preface without acknowledging all the authors and the persons who helped me in the book project together with all the societies (see the book cover) that motivated and sponsored the book. I'm personally grateful to Professors Giovanni Natile, Francesco De Angelis and Luigi Campanella for their motivation and support in this activity.

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