Young Career Focus: Professor Rongbiao Tong (Hong Kong University of Science and Technology, P. R. of China)

Background and Purpose. SYNFORM regularly meets young up-and-coming researchers who are performing exceptionally well in the arena of organic chemistry and related fields of research, in order to introduce them to the readership. This Young Career Focus presents Professor Rongbiao Tong (Hong Kong University of Science and Technology, P. R. of China).

Biographical Sketch

Prof. R. Tong

Rongbiao Tong was born in Guangdong province, P. R. of China. He received his BS and MS degrees in chemistry from Hunan University (P. R. of China) in 2000 and 2003, respectively. He continued his graduate studies on natural product synthesis under the guidance of Professor Frank E. McDonald at Emory University (Atlanta, GA, USA) and was awarded a PhD degree in 2008. After working with Professor Amos B. Smith, III at the University of Pennsylvania (Philadelphia, PA, USA) as a postdoctoral fellow (2008–2011), he started his independent research career as a tenure-track Assistant Professor in the Department of Chemistry at the Hong Kong University of Science and Technology (P. R. of China) in July 2011. His current research interests include the development of new synthetic methods and total synthesis of natural products by strategic exploitation of oxidative dearomatization of phenols and furfuryl alcohols and biosynthetic hypothesis.

INTERVIEW

SYNFORM *What is the focus of your current research activity?*

Prof. R. Tong My research group and I are particularly focused on the total synthesis of natural products through development of novel synthetic technologies and strategies, which are expected to lay the groundwork for other chemistry-related programs: drug discovery, new synthetic methodology, new natural product synthesis, and undergraduate/graduate student training. Strategically, oxidative dearomatization of phenols and furfuryl alcohols has been fully exploited in the early stage of our synthetic ventures, which further explore the biomimetic tactics, cascade reactions, skeletal rearrangements, non-classical chemical transformations to advance organic synthesis and the art and science of total synthesis. Our current targets include polyketides, di- and triterpenoids, diarylheptanoids, spiroketals, and alkaloids, most of which contain novel structural motifs and/or display potent and diverse biological activities. In addition, we are also interested in the development of new synthetic protocols that would not only complement the previous methods but also offer the advantages of practicability, simple operation, high efficiency, flexibility and/or scalability.

SYNFORM *When did you get interested in synthesis?*

Prof. R. Tong In 1999, it was time for me to choose a program for graduate studies, because my college days were coming to an end soon (2000) and chemistry-related industrial jobs were unattractive and very limited. In the course of in-depth reviewing of *Organic Chemistry* for the *Graduate Entrance Exam of China*, I was fascinated by the mechanisms of organic reactions (carbon–carbon bond formations and functional group interconversions) and the power of organic synthesis in making molecules. This interest was further consolidated at Emory University (USA, 2003–2008) where my PhD advisor Professor Frank E. McDonald taught the unbelievably thought-provoking *Advanced Organic Chemistry B* and guided me to pursue the most cutting-edge research in organic synthesis. The research experience at Emory together with the exceptional and inspirational guidance by Professor McDonald transformed me into an enthusiastic and optimistic organic chemist. My postdoctoral research under the guidance of Professor Amos B. Smith, III at the University of Pennsylvania (USA) certainly inspired me to think critically about the

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role of synthetic tactics in total synthesis and made me more interested in the development of practical synthetic methods.

SYNFORM *What do you think about the modern role and prospects of organic synthesis?*

Prof. R. Tong This is a tough question because organic synthesis has evolved tremendously over the past century and impacted nearly all aspects of our lives: clothing, foods, electronics, fuels (*c.f.*, energy and environment), drugs, etc. Organic synthesis will continue to play these traditional roles in contemporary research as the most effective tool to make substances at the molecular level with designed physical, chemical and biological properties. In particular, recent advances in chemical and molecular biology as well as organic materials science require organic synthesis in order to understand the underlying molecular mechanism and functions, which are still in their infancy. In this regard, I believe that organic synthesis will shape the future and development of biology and materials science. As for the development of organic synthesis itself (conventionally classified into synthetic methodology and total synthesis), new synthetic methods and synthetic strategies are updated daily, revolutionizing the way of making molecules, and demonstrating the creativity and imagination of human beings. Therefore, organic synthesis is rapidly evolving to address the challenges of molecular sciences and will continue to flourish in the coming decades.

SYNFORM *Your research group is active in the field of novel synthetic methods and total synthesis. Could you tell us more about your research and its aims?*

Prof. R. Tong Our research programs in the area of synthetic methods focus on the development of novel protocols to address the synthetic challenges in one or more of the following aspects: efficiency, practicability, scalability, accessibility, reproducibility, flexibility, etc. For example, (1) in situ generation of chlorine gas or its direct derivatives for diastereoselective dichlorination of alkenes was achieved by simple mixing of the nontoxic, low-cost oxone and sodium chloride; (2) substituted tetrahydropyran-4-ones could be rapidly and efficiently assembled in four steps from readily available enals, hydroxylamines, and alkenes; (3) the poorly accessible cis-fused bicyclic ethers could be forged by double cascade reactions: Achmatowicz rearrangement/bicycloketalization and spiroketal reduction/oxa-Michael cyclization. Our total synthesis programs aim at developing novel and/or general synthetic strategies for a family of natural products. In this regard, in the past five years we have developed four general strategies to access four families of natural products, respectively: cephalosporolides and SAFLs, 6,8-DOBCOs (Scheme 1), protoberberines and aporhaeadanes, and *trans*-2-aryl-6-alkyltetrahydropyrans. One of the key features of these synthetic strategies is to explore the oxidative dearomatization of phenols and furfuryl alcohols (Scheme 1). On the other hand, we are interested in biomimetic synthesis of structurally novel natural products such as tenuipyrone, penicipyrone, spirooliganones A and B, ascospiroketals A and B, etc. through development of new biomimetic cascade reactions.

SYNFORM *What is your most important scientific achievement to date and why?*

Prof. R. Tong Each project (synthetic method or total synthesis) addresses a synthetic challenge or problem, which has its scientific value and importance on one hand or the other, specifically or generally. For example, we reported first total syntheses of natural products that confirmed the molecular structures and provided a viable strategy and route for their chemical synthesis. If a biomimetic approach is employed in the synthesis, the corresponding biosynthesis is well supported by such synthetic studies. We are not able to evaluate which of these contributions is the most scientifically important one. However, if pressed to say something about it in my early career, I would like to recommend the exploitation of the Achmatowicz rearrangement (AchR) in total synthesis of natural products. We have made tremendous efforts to expand the synthetic utilities of the Achmatowicz rearrangement in organic synthesis, which has led to the development of concise synthetic strategies for the total syntheses of musellarins A–C in both racemic and enantioselective fashions, uprolide G acetate, uprolide F diacetate, psoracorylifol B, *ent*-psoracorylifol C, attenols A and B, didemniserinolipid B, diospongin B, and parvistones D and E.

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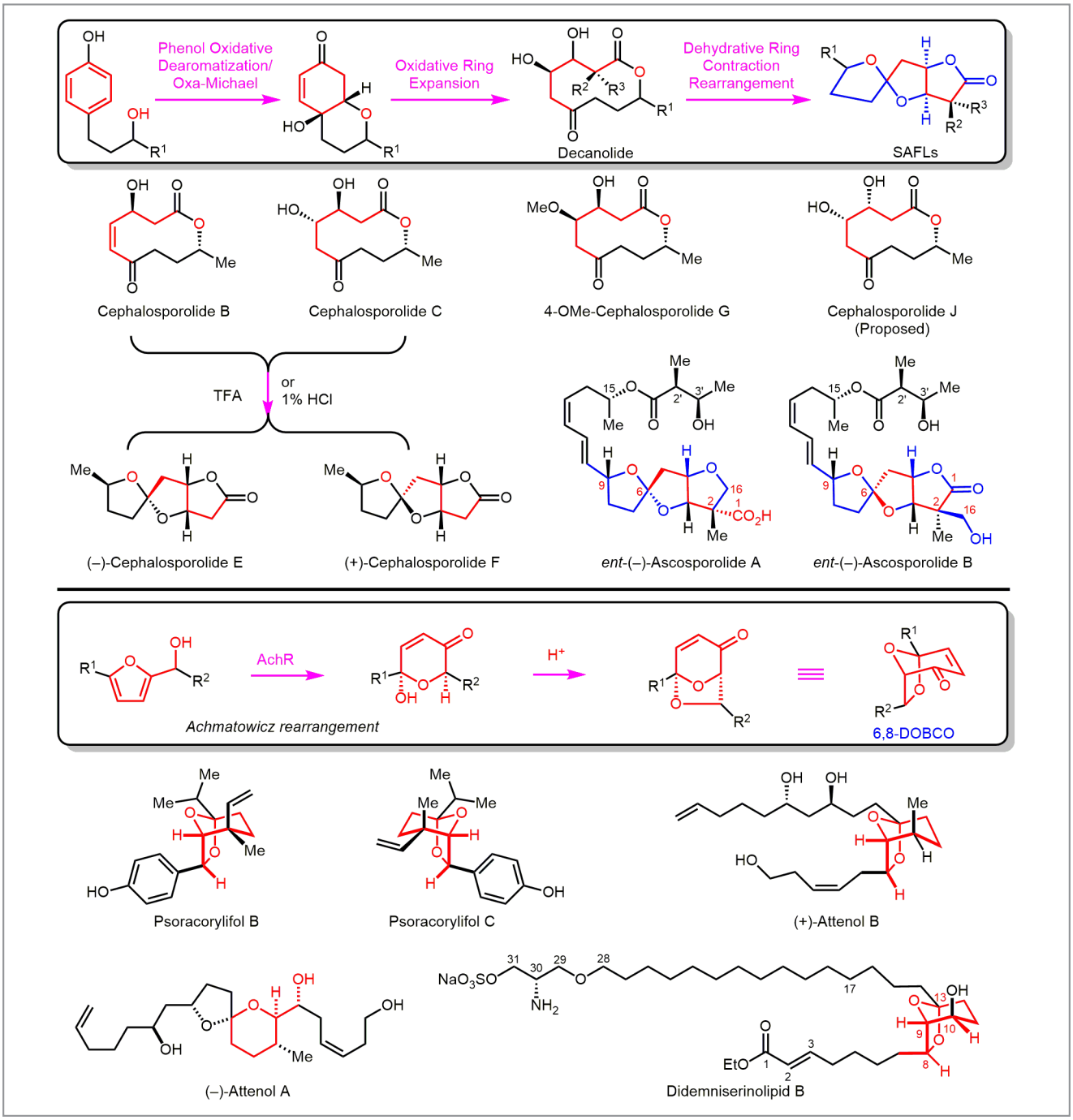

Scheme 1 General synthetic strategies for the total synthesis of cephalosporolides and SAFLs and 6,8-DOBCO-containing natural products