

## Young Career Focus: Professor Dr. Michal Juríček (University of Zurich, Switzerland)

**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 Dr. Michal Juríček (University of Zurich, Switzerland).

### Biographical Sketch



Prof. Dr. M. Juríček

**Michal Juríček** was born in Bojnice and raised in Prievidza, two small cities in Slovakia. He received his Master's degree in organic chemistry in 2005 from the Comenius University in Bratislava (Slovakia), where he explored the stereochemistry of binaphthyls under the supervision of Professor Martin Putala. He then moved to The Netherlands to pursue his PhD at the Radboud University Nijmegen mentored by Professor Alan Rowan. His dissertation work revolved around the chemistry of triazoles, which he employed in the design and synthesis of functional materials. In 2011, he received Dutch fellowship Rubicon and went on to spend two years at Northwestern University in Evanston (USA). There, as a postdoctoral scholar in the group of Professor Sir Fraser Stoddart, he extended the size of tetracationic cyclophanes to sequester hydrocarbon pollutants, mimic enzyme catalysis, and make molecular switches. In 2013, he returned to Europe and started his independent research career in Switzerland: first at the University of Basel as an Ambizione fellow of the Swiss National Science Foundation (SNSF) hosted in the group of Professor Marcel Mayor and, as of April this year, as an Assistant Professor at the University of Zurich, where his research is supported by the European Research Council and SNSF. His group designs, synthesizes, and investigates functional organic molecules with delocalized spin densities. Michal is a 2017 recipient of the Thieme Chemistry Journals Award.

### INTERVIEW

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

**Prof. Dr. M. Juríček** Our group develops functional materials based on organic molecules that contain one or more unpaired electrons for applications in spin electronics or simply 'spintronics'. The research in our group lies at the interface between organic synthesis, physical organic chemistry, materials science and supramolecular chemistry, and revolves around spin-delocalized open-shell systems. Our biggest excitement is to design and make molecules, where new functionality arises from the presence of unpaired electrons and spin interactions between them.

**SYNFORM** *When did you get interested in synthesis?*

**Prof. Dr. M. Juríček** During my high-school years, for which I am indebted to my chemistry teacher Miroslav Kozák, who motivated me to participate in Chemistry Olympiads. Organic chemistry fast became my favorite topic and in the third and the fourth year of my high-school studies, I had my first experience with organic synthesis. Later during my undergraduate studies in Bratislava, my interest in making and studying new molecules deepened and ever since it has remained my passion. One of the reactions that I enjoyed performing the most is one step in the synthesis of hexacene reported<sup>1</sup> by Chow. This step was mediated by 3,6-di(pyridin-2-yl)-1,2,4,5-tetrazine, a bright magenta solid, and involved a double sequence of Diels–Alder and retro-Diels–Alder reactions and release of two molecules of dinitrogen per one molecule of product. It was fascinating to see how the beautiful magenta color turned black while heaps of gas formed. After the work-up, the product was isolated as a white solid.

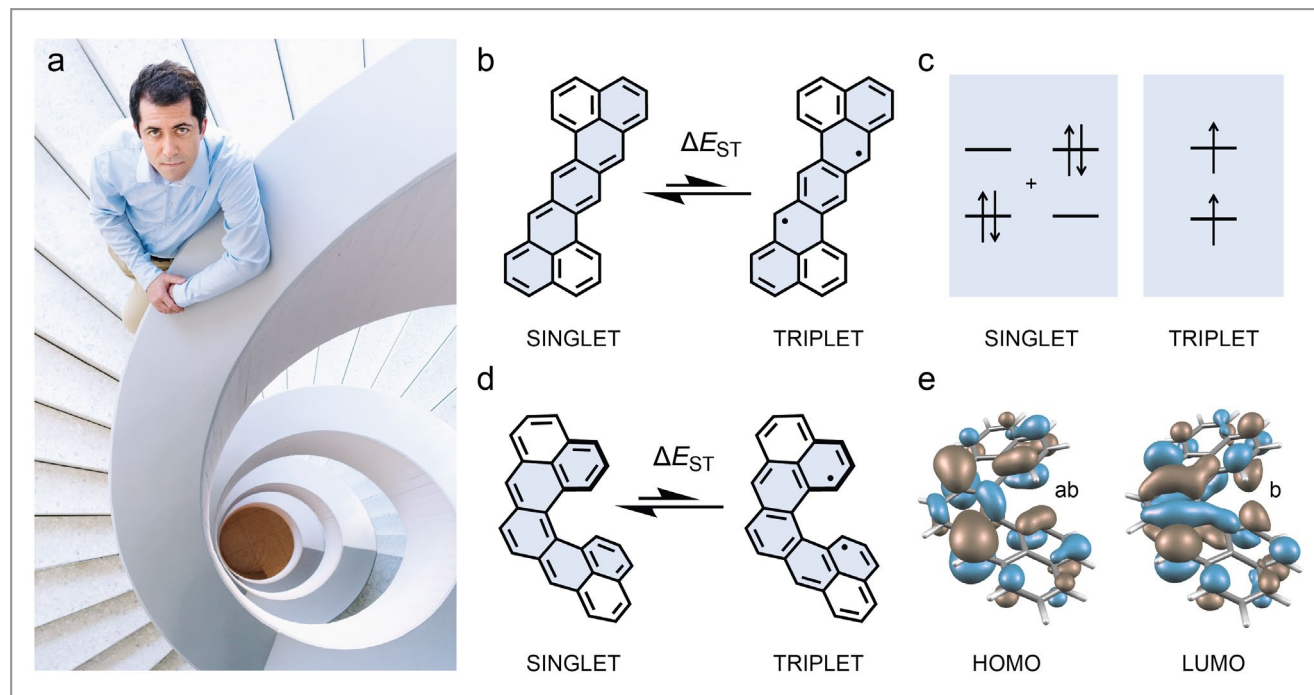
**SYNFORM** What do you think about the modern role and prospects of organic synthesis?

**Prof. Dr. M. Juriček** Our group does not develop new reactions or methods, unless it happens by serendipity. But we do use reactions to synthesize our targets and rely on efficient methodologies that are available. Often, it is the latest synthetic advancement that makes it possible for us to reach the molecules of our interest. I therefore believe that the development of new organic reactions and methods – whether they are catalyzed, sustainable, or not – plays and will play a central role in accessing structural motifs that are not within reach by current synthetic means. This is equally important for materials science as it is for natural product synthesis and other fields.

**SYNFORM** Your research group is active in the areas of organic chemistry and materials science. Could you tell us more about your research and its aims?

**Prof. Dr. M. Juriček** Our aim is to learn how to introduce and control multiple functionalities in a bulk material

assembled from molecules that contain unpaired electrons through manipulation of spin interactions within and between the molecules. One type of molecule that we investigate is  $\pi$ -conjugated Kekulé hydrocarbons with a biradicaloid singlet ground state and a low-lying triplet excited state that can be populated thermally (Figure 1c). One of the strategies that we use to control the spin interactions is that we ‘embed’ unpaired electrons within a helical  $\pi$ -conjugated backbone reminiscent of a helical staircase (Figure 1a). Last year, we reported<sup>2,3</sup> the first molecule of this kind, namely, a helically twisted ‘C’-shaped *cethrene* (Figure 1d), an isomer of a planar ‘Z’-shaped *heptazethrene*<sup>4</sup> (Figure 1b). We showed that in *cethrene*, the singlet–triplet energy gap is markedly lower (5.6 kcal mol<sup>-1</sup>) than that of its isomer *heptazethrene* (8.9 kcal mol<sup>-1</sup>), on account of through-space interactions that arise within the frontier molecular orbitals because of the helical twist (Figure 1e). The next step is to explore the effect of other parameters, so that we can alter the size of this gap even further. This would allow us to fine-tune the properties on a molecular level and systematically investigate how they impact the properties in the bulk.



**Figure 1** (a) Prof. Dr. M. Juriček on the left-handed helical staircase at the University of Zurich and (d) molecular helix *cethrene* made in the Juriček group. The singlet–triplet gap ( $\Delta E_{ST}$ ) of *cethrene* is lower than that of (b) its planar isomer *heptazethrene* on account of (e) through-space interactions within HOMO (ab = antibonding) and LUMO (b = bonding). (c) Both compounds have biradicaloid singlet ground state and low-lying triplet excited state.

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

**Prof. Dr. M. Juríček** For me, the most important and exciting achievements are always the latest findings from our group, which are at the time still in the process of being fully understood. Then there is the thrill of not-knowing-but-trying-to-find the right answer. Currently, we are completing one study, dealing with unusual reactivity of cethrene, which we are very excited about.



## REFERENCES

- (1) M. Watanabe, Y. J. Chang, S.-W. Liu, T.-H. Chao, K. Goto, M. M. Islam, C.-H. Yuan, Y.-T. Tao, T. Shinmyozu, T. J. Chow *Nat. Chem.* **2012**, *4*, 574.
- (2) P. Ravat, T. Šolomek, M. Rickhaus, D. Häussinger, M. Neuburger, M. Baumgarten, M. Juríček *Angew. Chem. Int. Ed.* **2016**, *55*, 1183.
- (3) P. Ravat, T. Šolomek, P. Ribar, M. Juríček *Synlett* **2016**, *27*, 1613.
- (4) Y. Li, W.-K. Heng, B. S. Lee, N. Aratani, J. L. Zafra, N. Bao, R. Lee, Y. M. Sung, Z. Sun, K.-W. Huang, R. D. Webster, J. T. López Navarrete, D. Kim, A. Osuka, J. Casado, J. Ding, J. Wu *J. Am. Chem. Soc.* **2012**, *134*, 14913.