Angewandte Chemie International Edition

F. Würthner

*The author presented on this page has published more than **25 articles** since 2000 in Angewandte Chemie, most recently:* "Molecular Assemblies of Perylene Bisimide Dyes in Water": D. Görl, X. Zhang, F. Würthner, *Angew. Chem.* **2012**, *124*, 6434–6455; *Angew. Chem. Int. Ed.* **2012**, *51*, 6328–6348.

Frank Würthner

Date of birth:	June 27, 1964
Position:	Professor of Organic Chemistry and Head of the Center for Nanosystems Chemistry, University of Würzburg (Germany)
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Education:	1984–1990 Undergraduate studies in chemistry at the University of Stuttgart (Germany) 1993 PhD with Franz Effenberger at the University of Stuttgart 1994–1995 Postdoctoral fellow with Julius Rebek at MIT (USA) 1995–1996 Industrial Chemist in the Colors Laboratory, BASF (Ludwigshafen, Germany) 2001 Habilitation in Organic Chemistry at the University of Ulm (Germany)
Awards:	**2000** Award from the Otto Röhm Memorial Foundation; **2002** Arnold Sommerfeld Award from the Bavarian Academy of Sciences and Humanities; **2009** Steinhofer Award from the University of Freiburg
Current research interests:	My research interests include dyes and π systems that organize into larger molecular assemblies through the guidance of suitable substituents or interactions with other molecules, the study of thermodynamic and kinetic control of self-assembly processes in solution, and the study of the functional properties of these assembled dye systems. Currently, I am particularly inspired by the use of supramolecular interactions to control the organization of nanostructures, bulk materials and thin films for organic electronics and photovoltaics, as well as the fascinating structures and research opportunities that arise from the self-assembly of amphiphilic dyes in water. In the future I would like to learn more about biological systems in order to apply new custom dye molecules and their self-assemblies in biological environments.
Hobbies:	Hiking, skiing, opera, exploring foreign countries and their cultures

Looking back over my career, I … would say that some detours were worth it.

When I was eighteen I wanted to be … a chemistry student, however, first I had to spend one year in the army.

If I were an animal … I would like to be an eagle.

Chemistry is fun because … as a scientist and especially as a professor you can enjoy much greater freedom than in other professions and you are always surrounded by young and enthusiastic co-workers.

The biggest challenge facing scientists is … to ensure a sustainable and environmentally friendly energy supply for a growing world population.

Young people should study chemistry because … it is the science with which this biggest challenge for humankind can be solved in the coming decades.

The most significant historic event of the past 100 years was … the unification of western and eastern Europe and the concomitant reunification of Germany.

The most important future applications of my research are … hopefully not just a dream.

My first experiment was … to smear my mother's oven with shoe polish.

My favorite quote is … "Choose a job you love, and you will never have to work a day in your life" (Confucius).

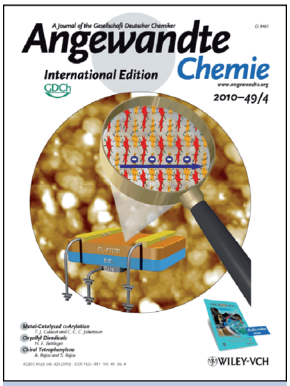
I admire … my co-workers, when they persistently search for a solution despite numerous unsuccessful experiments.

My favorite way to spend a holiday is … being in the mountains or at the ocean without a laptop or smartphone.

My science "heroes" are … Emil Fischer and Theodor Förster.

The most important thing I learned from my students is … that people and projects have to match.

My favorite musician is … my wife.



The work of F. Würthner has been featured on the cover of Angewandte Chemie: "A Crystal-Engineered Hydrogen-Bonded Octachloroperylene Diimide with a Twisted Core: An n-Channel Organic Semiconductor": M. Gsänger, J. H. Oh, M. Könemann, H. W. Höffken, A.-M. Krause, Z. Bao, F. Würthner, *Angew. Chem.* **2010**, *122*, 752–755; *Angew. Chem. Int. Ed.* **2010**, *49*, 740–743.

How has your approach to chemistry research changed since the start of your career?

If you have conducted successful research, you are rewarded with a flow of high-quality co-workers. As a result, and in particular because of globally mobile postdoctoral candidates who can contribute their own complementary expertise, the ability to pursue new ideas is improved. Here, I think there is really a fundamental difference compared with the beginning of my career. At that time, this privilege was subject only to the top American universities and in Germany to the Max Planck Institutes. Today, interdisciplinary research can be conducted also at German Universities by shaping a research team with complementary expertise by the involvement of excellent foreign postdocs.

How do you think your field of research will evolve over the next 10 years?

Nowadays, more than in any other field of organic chemistry, the application of supramolecular principles belongs in the repertoire of preparative chemists working on the development of organic functional materials. I assume that this trend will continue and in particular, organic electronics and photovoltaics will become more "colorful" in the upcoming years. To make progress here and in other areas, self-organization processes will play an increasingly important role in designing complex multicomponent mixtures and bulk materials/solids with emergent applications. And of course, self-assembly processes should also be useful in water and finally in a biological milieu where the number of unknown parameters increases considerably!

My 5 top papers:

1. "Hierarchical Organization of Functional Perylene Chromophores to Mesoscopic Superstructures by Hydrogen Bonding and π–π Interactions": F. Würthner, C. Thalacker, A. Sautter, *Adv. Mater.* **1999**, *11*, 754–758.
   We examined the formation of extended aggregate structures of perylene bisimide dyes and thus opened a still very active research field. The extremely low solubility of these pigment chromophores was overcome by insertion of phenoxy substituents into the four bay positions. Subsequently, supramolecular polymers were formed by adding hydrogen-bonding dialkylmelamine derivatives. The resulting aggregates in solution and surface deposited mesoporous networks are characterized by exceptional fluorescence and exciton transport properties.
2. "Dimerization of Merocyanine Dyes. Structural and Energetic Characterization of Dipolar Dye Aggregates and Implications for Nonlinear Optical Materials": F. Würthner, S. Yao, T. Debaerdemaeker, R. Wortmann, *J. Am. Chem. Soc.* **2002**, *124*, 9431–9447.
   The thermodynamic stability of the dimer aggregates in dependency of structural parameters and the solvent polarity was analyzed and an interpretation of the aggregates' absorption bands based on exciton theory was carried out. Based on the solvent dependency of the aggregation constants, the major contribution to the binding constant is the electrostatic attraction, which results from the antiparallel orientation of the dipole moments. This paper explains why merocyanines are less successful than expected in nonlinear-optical devices. It also explains why—much later, see Ref. [5]—merocyanine dyes can be successfully applied in solar cells.
3. "Supramolecular Construction of Fluorescent J-Aggregates Based on Hydrogen-Bonded Perylene Dyes": T. E. Kaiser, H. Wang, V. Stepanenko, F. Würthner, *Angew. Chem.* **2007**, *119*, 5637–5640; *Angew. Chem. Int. Ed.* **2007**, *46*, 5541–5544.
   Self-assembly of perylene bisimide dyes produced intensely fluorescent J-aggregates through a twist of the perylene scaffold and the influence of hydrogen bonds. As a result of the fluorescence quantum yield of almost 100 % and the instantaneous growth of these aggregates at a critical concentration (so-called nucleation elongation mechanism, proven in a subsequent paper), a multitude of further studies became possible, such as the determination of exciton diffusion lengths by means of single-molecule spectroscopy.
4. "Vesicular perylene dye nanocapsules as supramolecular fluorescent pH sensor systems": X. Zhang, S. Rehm, M. Safont-Sempere, F. Würthner, *Nature Chem.* **2009**, *1*, 623–629.
   I have always been fascinated by the variety of functions cellular compartments and chloroplasts exhibit. With this paper, we were able—and this was scientifically unknown territory for us—to produce a kind of artificial liposome through the self-assembly of amphiphilic perylene dyes into a vesicular membrane, with internally solvated bispyrene-chromophores that functioned as a pH-probe via a pH-dependent FRET-process. It is fascinating how many interesting self-organized nanosystems based on new unconventional amphiphiles are being published at the moment, and it is an interesting question to ponder the possible applications of these systems in the life sciences.
5. "Efficient Solution-Processed Bulk Heterojunction Solar Cells by Antiparallel Supramolecular Arrangement of Dipolar Donor–Acceptor Dyes": H. Bürckstümmer, E. V. Tulyakova, M. Deppisch, M. R. Lenze, N. M. Kronenberg, M. Gsänger, M. Stolte, K. Meerholz, F. Würthner, *Angew. Chem.* **2011**, *123*, 11832–11836; *Angew. Chem. Int. Ed.* **2011**, *50*, 11628–11632.
   The supramolecular chemist is often accused of creating beautiful structures that are useless. Here, the aggregation of dipolar merocyanines (see Ref. [2]) led to highly efficient bulk heterojunction solar cells, for which no expert in the field of organic electronics would have bet on functioning because of their unfavorable dipolarity. However, upon aggregation into centrosymmetric dimers the dipolarity vanishes on the supramolecular level and efficient charge and exciton transport becomes possible.

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