Special Topic Articles Featuring the 2005 Winners of the IUPAC Prizes for Young Chemists

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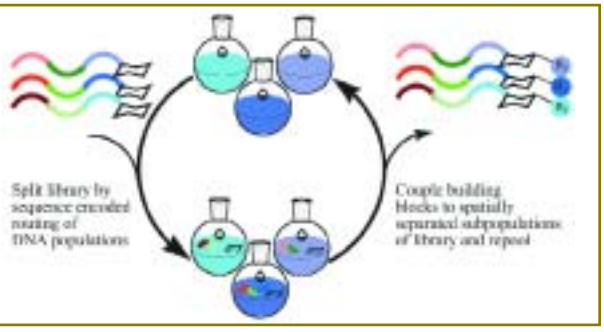
As an international nongovernmental scientific organization, IUPAC takes great interest in the worldwide achievements of chemists, particularly young chemists. Therefore, IUPAC established the annual prestigious Prizes for Young Chemists. In doing so, we endeavor to encourage research in the chemical sciences and the participation of promising young chemists.

Starting in 2002, prizewinners have been invited to submit manuscripts on aspects of their research topics for consideration as short, critical review articles to be published in *Pure and Applied Chemistry*. Following peer review, the first collection appeared in *PAC* **74**(11), 2021–2081 (2002) and encouraged the view that it offers sufficient readership appeal to become a regular special topic feature of the journal. The second series, covering the works of the 2003 winners was published in *PAC* **76**(2), 263–319 (2004), and the third series in *PAC* **76**(12), 2051–2099 (2004). The most recent series of articles was published in the January 2006 issue of *PAC* and includes the following critical reviews:

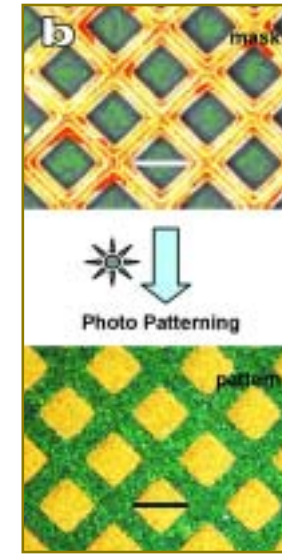
"Evolutionary Approaches for the Discovery of Functional Synthetic Small Molecules," by Zev J. Gartner (pp. 1-14)

Directed evolution is a powerful method for the laboratory discovery of nucleic acids and proteins with desired functional properties. A hallmark of this approach is the iterative translation, selection, amplification, and diversification of genetic information. The potential of evolutionary methods to impact the discovery of synthetic small molecules has recently been explored by a variety of laboratories. Four methods encompassing some or all of the hallmarks of evolution are discussed, including dynamic combinatorial chemistry, genetic algorithms, DNA display, and DNA-templated synthesis.



DNA display: DNA libraries are split into subpopulations according to their sequences. Each subpopulation, having in common a particular DNA codon, is subjected to a particular set of reaction conditions. The reacted subpopulations are re-pooled and subjected to further manipulations. (by Z.J. Gartner)

Flash welding technique can be used to create patterns in nanofiber films. The top optical microscopy image shows a copper grid mask lying on top of a polyaniline nanofiber film. After exposure to a camera flash, the grid pattern is generated on the nanofiber film. The unmasked diamond shaped areas are welded, therefore, reflect more light and look bright under an optical microscope. The previously masked areas still look green (scale bar:100 m). (by J. Huang)



"Syntheses and Applications of Conducting Polymer Polyaniline Nanofibers," by Jiaxing Huang (pp. 15-27)

Nanofibers with diameters of tens of nanometers appear to be an intrinsic morphological unit that was found to "naturally" form in the early stage of the chemical oxidative polymerization of aniline. In conventional polymerization, nanofibers are subject to secondary growth of irregularly shaped particles, which leads to the final granular agglomerates. The key to producing pure nanofibers is to suppress secondary growth. Based on this, two methods—interfacial polymerization and rapidly mixed reactions—have been developed that can readily produce pure nanofibers by slightly modifying the conventional chemical synthesis of polyaniline without the need for any template or structural directing material. With this nanofiber morphology, the dispersibility and processibility of polyaniline are now much improved. The nanofibers show dramatically enhanced performance over conventional polyaniline applications such as in chemical sensors. They can also serve as a template to grow inorganic/polyaniline nanocomposites that lead

to exciting properties such as electrical bistability that can be used for nonvolatile memory devices. Additionally, a novel flash welding technique for the nanofibers has been developed that can be used to make asymmetric polymer membranes, form patterned nanofiber films, and create polymer-based nanocomposites based on an enhanced photothermal effect observed in these highly conjugated polymeric nanofibers.

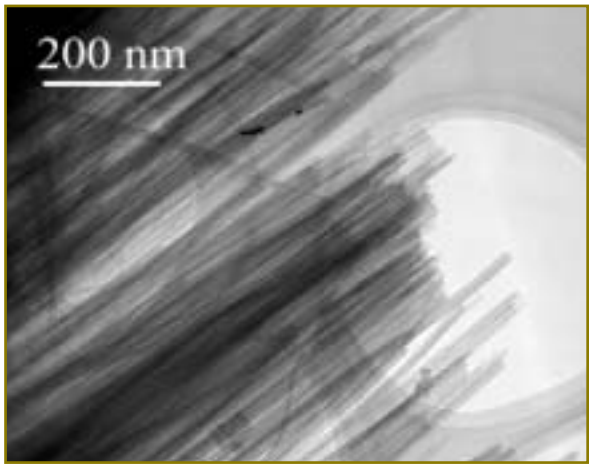
"A Dozen Years of N-Confusion: From Synthesis to Supramolecular Chemistry," by Hiromitsu Maeda and Hiroyuki Furuta (pp. 29-44)

The chemistry of N-confused porphyrin (NCP) and its analogs started in 1994. Since then, considerable progress has been made in understanding the unique properties of NCP and its analogs, which confer characteristic reactivity and metal complex formation. The evolved isomers, multiply NCPs, and expanded N-confused derivatives, have opened up new realms of NCP chemistry. *Cis*- and *trans*-doubly N-confused porphyrin (N_2CP) stabilizes higher oxidation states such as Cu^{III} in square-planar fashion in the core. Confused isomers with five or more pyrrole rings can coordinate several cations owing to their larger cavities compared to tetrapyrrolic system. The peripheral nitrogen(s) of NCP and its analogs can serve as hydrogen-bonding donor and acceptor, and metal coordination site as well. For example, NCP forms versatile dimers with the assistance of metal ions. The square-planar divalent metal complexes of C_6F_5-substituted NCP act as efficient anion-binding receptors. Furthermore, Cu^{III} complexes of N_2CP, possessing both N and NH at the periphery, form self-assembled one-dimensional (1D) hydrogen-bonding networks, whose orientations differ in *cis* (zigzag) and *trans* (straight) isomers.

"Solution-Based Routes to Transition-Metal Oxide One-Dimensional Nanostructures," by Xun Wang and Yadong Li (pp. 45-64)

One-dimensional (1D) nanostructures have drawn continuous research attention because of their unique electrical, optical, and magnetic properties different from that of bulk and nanoparticles, as well as their potential applications in mesoscopic research and nanodevices. The main challenge in this area is how to precisely control the sizes, dimensionalities, compositions, and crystal structures in nanoscale, which may serve as a powerful tool for the tailoring of physical/chemical properties of materials in a controllable way. Here, we review the advances in the solution-based routes to prepare 1D nanostructures. Particularly, three systems of MnO_2, rare-earth compounds, and silicates have been chosen to show the synthetic strategy under hydrothermal conditions. As the main theme, a rolling mechanism has been given special attention to present a relative general understanding of the growth of various transition-metal oxide 1D nanostructures under solution conditions.

www.iupac.org/publications/pac/2006/7801



TEM image of δ-MnO_2 nanotubes with α-$NaMnO_2$ as precursors. (Xun Wang)

Evolution of the N-confused porphyrin (NCP) family. (by H. Maeda)