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Introducing the Research Front on Photoactive and Electroactive Dendrimers

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In the past 20 years several emerging topics in Chemistry have stimulated the enthusiasm and creativity of researchers.[1] One of them is certainly that of dendritic molecules. Originally, the interest about dendrimers was in the synthetic challenge represented by the construction of macromolecules with controlled structure following the idea of 'branching branches'.[2] With the successive development of reliable and convenient strategies for the preparation of dendrimers,[3] the interest moved progressively from synthesis and structure to functions.[4] As a matter of fact, dendrimers are superior platforms for the incorporation of many active subunits in a single molecular architecture. Such moieties can be positioned within the dendritic framework according to precise and predetermined patterns, taking advantage of flexible synthetic methodologies and the peculiar stereochemical, conformational, and topological features of dendrimers. In fact, as the branches of a tree bear leaves, flowers, and fruits, a dendrimer can be decorated in different positions by functional units of various types. The degree of structural sophistication and functional organization reached by dendrimers can be appreciated by looking at the recent literature.[5]

Research on dendritic molecules embraces almost every area of Chemistry: organic and inorganic synthesis and catalysis, physical chemistry, supramolecular chemistry, materials science, analytical chemistry, nanoscience. Moreover, dendrimers are potentially interesting to develop systems for real life applications, such as: phase transfer agents, nanoreactors, drug delivery agents and antitumor drugs, chemosensors with signal amplification, materials and devices for the generation and processing of light signals (e.g. electroluminescence, photon funnelling, or upconversion) and for the accumulation of charge (molecular batteries). Despite the fact that the synthetic costs for dendrimers are yet higher than those for conventional polymers, industrial patenting and commercialization of dendrimer-based products for technological[6] and biomedical[7] applications are developing at a remarkable rate.

Dendrimer chemistry, as witnessed by several books[8] and the number and size of the research groups involved, has become so popular that a single journal issue cannot even give a taste of the field. This is why the present Research Front concentrates on dendritic molecules with photochemical and/or electrochemical functionalities. The Research Front is opened by an essay from Vincenzo Balzani, one of the leading authorities in the field, who briefly and clearly summarizes the potentialities of photoactive and electroactive dendrimers for research and applications. In their short review, Paola Ceroni and Margherita Venturi provide an insightful introduction on photochemical and electrochemical processes in dendrimers, and illustrate a selection of representative examples for various functionalities, including electron-transfer catalysis, charge storage, light energy harvesting and upconversion, and sensing. Jean-François Nierengarten, Nicola Armaroli, Alain Van Dorsselaer, Béatrice Delavaux-Nicot, and coworkers present the synthesis and properties of a fullerene-cored dendrimer bearing 12 stilbene-type branches; the latter are capable of absorbing UV photons and transferring the corresponding electronic energy to the C_{60} core, which emits red light. Jian Pei and colleagues report on conjugated dendrimers substituted with carbazole moieties and on their application as blue emitters in organic light-emitting diode devices. In their paper, Carmen Casado, Beatriz Alonso, and coworkers describe the preparation, characterization, and redox properties of thin films obtained by crosslinking ferrocenyl-based dendrons with a sol-gel approach.

I hope that this minuscule but valuable collection of papers will enable the readers to appreciate the progresses made on photoactive and electroactive dendrimers, and to glimpse some of the scientific challenges and applicative opportunities that the future is offering to this fascinating research area.

Alberto Credi was born in 1970. He received his 'Laurea' (1994) from the University of Bologna where, after a research period in the USA, he also earned his Ph.D. (1999). He is currently Associate Professor of Chemistry at his Alma Mater. He received several scientific awards and co-authored more than 180 scientific papers in the fields of supramolecular chemistry, molecular devices, photochemistry, and electrochemistry. He is also the co-author of a monograph entitled 'Molecular Devices and Machines*', and of a handbook of photochemistry. Since January 2009 he is an Associate Editor (Commissioning) of the* Australian Journal of Chemistry.

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[6] (a) See, e.g.: P. E. Froehling, *U.S. patent 6,232,378* **2001**.
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[8] (a) See, e.g.: G. R. Newkome, F. Vögtle, *Dendrimers and Dendrons* **2001** (Wiley-VCH: Weinheim).
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