Molecular Crystals and Liquid Crystals Incorporating Nonlinear Optics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl17

Preface

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Version of record first published: 22 Sep 2006.

To cite this article: Joel S. Miller & Dennis A. Dougherty (1989): Preface, Molecular Crystals and Liquid Crystals Incorporating Nonlinear Optics, 176:1, vii-viii

To link to this article: http://dx.doi.org/10.1080/00268948908037462

Mol. Cryst. Liq. Cryst., Vol. 176, pp. vii–viii
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Printed in the United States of America

PREFACE

The symposium on Ferromagnetic and High Spin Molecular Based Materials convened April 9 - 12, 1989 as part of the 197th National American Chemical Society (ACS) meeting in Dallas, TX. This volume of *Molecular Crystals, Liquid Crystals* contains the proceedings from this first symposium that focuses upon several key aspects that directly relate to design, preparation, and characterization of high spin and molecular/polymeric ferromagnets.[1]

This multidisciplinary meeting brought together inorganic, organic, organometallic, polymer, and physical chemists as well as theoretical and experimental condensed matter physicists from Japan, USSR, UK, France, Germany, Italy, Spain, Bulgaria, and the USA. Although not part of the written proceedings, the symposium comprised a Tutorial and sessions devoted to the preparation and characterization of a 'designer magnet' from organic, organometallic, inorganic, and polymeric materials. This broad interdisciplinary symposium was reflected in its co-sponsorship by the Divisions of Inorganic, Organic, Polymer, and Physical Chemistry of the ACS and additionally supported by the Petroleum Research Fund and Gordon & Breach, Science Publishers, Inc. A total of 39 verbal and 25 poster papers were presented and 49 contributions are published herein.

The Sunday Tutorial enabled symposium attendees to understand the conceptual framework on which the current understanding of cooperative magnetic phenomena in molecular/organic/polymeric systems exists. Dennis A. Dougherty - California Institute of Technology - concisely reviewed the key

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[1] See *Angew. Chem. Adv. Mater.* **101**, 985 (1989); *Angew. Chem. Int. Ed. Adv. Mater.* **28**, 961 (1989); *Adv. Mater.* 239 (1989) for a complete trip report.

criteria for stabilizing a triplet ground state; the building block of a high spin molecule or polymer. Joel S. Miller - Du Pont Central Research - described the existing paradigms, while the fundamental physics of magnetism were reviewed by Arthur J. Epstein Ohio State. Models for magnetic order and neutron diffraction aspects were presented by Peter Day - Institut Laue-Langevin. Robert M. White - Control Data Corp. - provided insight into the realities of opportunities for molecular based magnets. Due to the low density, high molecular weight, and low spin-orbit coupling, competition with existing magnets seems unlikely; however, opportunity might exist for fine particle and magneto-optic recording.

The strategies for designing molecular/polymeric materials with ferromagnetic coupling include: [1] unpaired electrons in orthogonal orbitals sharing the same spatial region, [2] Heitler-London spin exchange, [3] antiferromagnetic coupling of sites with differing S values (ferrimagnet), [4] conjugated odd-alternate hydrocarbons, [5] polaronic, conjugated block copolymers, and [6] configurational admixture of triplet charge transfer excited state. High spin systems demonstrating feasibility of several of the strategies were discussed and a few high moment materials were described. Universally it was emphasized that the rational design of solid state structures remains an art that limits our ability to prepare the secondary and tertiary structures needed to test many concepts in solid state chemistry. Frequently, complex, solvated compositions with undesired or new structure types form instead of the desired phase. Additionally, several polymorphs may form in lieu of the desired structure type. This is particularly crucial for the formation of a bulk ferromagnet as ferromagnetism is a 3-D (bulk) not 1-D property.

Clearly the embryonic quest for molecular/polymer based magnetic materials is a thriving area of research. The synthetic challenges are formidable as ferromagnetism being a bulk not molecular property requires materials with specific primary, secondary, and tertiary structures be made. The rational design of solids remains an art that limits our ability to prepare such structures. Nonetheless, several examples of deliberately designed high moment, magnetically ordered materials have been prepared and we look toward a future where ferromagnetic phenomena can be added to the repertoire of physical properties enjoyed by molecular/polymeric materials.

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