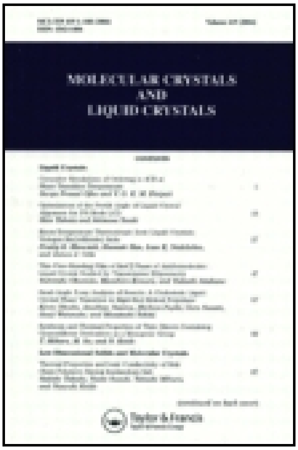

Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

A Review of: ""Organic Electroluminescent Materials and Devices", Edited by S. Miyata and H. S. Nalwa, Gordon and Breach Science Publishers, Amsterdam, 1997; ISBN 2-919875-10-8; x + 487 pages, 12 color plates; $180.00"

Bing R. Hsieh [a]

[a] Xerox Webster Research Center, 800 Philips Road, Webster, New York, 14580

Version of record first published: 24 Sep 2006

Mol. Cryst. Liq. Cryst., Vol. 326, pp. 425–427
Reprints available directly from the publisher
Photocopying permitted by license only

Book Review

"Organic Electroluminescent Materials and Devices" Edited by S. Miyata and H. S. Nalwa, Gordon and Breach Science Publishers, Amsterdam, 1997; ISBN 2-919875-10-8; x + 487 pages, 12 color plates; $180.00

The phenomenon of electroluminescence (EL) in organic materials was first observed in anthracene single crystals in the early 1960s. For the next 20 years, EL in organic materials gained little attention and remained an obscure laboratory curiosity. A turning point occurred in 1984 when a Kodak patent disclosed highly efficient organic light-emitting diodes (OLED) based on multi-layer evaporated molecular thin films. The 1990 publication from the Cambridge group on poly(p-phenylene vinylene) (PPV) LEDs further triggered a global interest in OLED for flat panel display applications. Research in the field has since been moving rapidly and many groups have announced highly stable polymer devices this year. The era of plastic electronics has started and this book provides a timely account of the progress of organic EL materials and devices up to 1996.

The editors had good intentions when placing a paper dealing with the fundamental processes in OLEDs as the first chapter; however this chapter entitled "Electronic Processes in Organic Electroluminiscence" falls short of what it meant to deliver. To avoid confusion, readers may want to learn related information from Chapters 2 and 13. Although the exact nature of the electronic processes in OLEDs is likely to be highly material and process dependent, these two chapters do provide a reasonable foundation and discussion on the subject. Chapter 2 by W. Riess on PPV LEDs derived from a sulfonium precursor route is an outstanding contribution, in light of the fact that LEDs fabricated on precursor polymers have very low reproducibility as reflected by a 200-fold variation on the efficiencies for seemingly identical devices. This work not only gives a comprehensive and systematic report on representative properties for both single and multi-layer PPV LEDs but also provides an excellent discussion of both chemical and electronic processes. Chapter 3 by O. Inganas is a review of the author's work on LEDs based on soluble poly(thiophenes). Although poly(thiophene)s are not particularly attractive for high performance LEDs, the new materials and device concepts provided are noteworthy and can be adapted in other materials sets. Chapter 4 by J. Shinar reviews his work on optically detected magnetic resonance studies of several EL conjugated polymers. The author has extended this technique to investigate the electronic processes in molecular OLEDs.

The widely practiced molecular-doped polymer (MDP) concept in commercial xerographic photoconductors appears to be highly promising for OLED applications. Some possible advantages include ease of fabrication and large area and flexible devices. As illustrated in Chapters 5, 6, 10, 12 and 14, the MDP approach has enabled high performance single layer and multi-layer EL devices with different color of emission, including white light. Chapter 5 reports multilayer LEDs based on molecularly-doped polyvinylcarbazole (PVK) and Alq. Since PVK has been used widely for LED work, the authors should have provided more background information and cited more related references. Chapter 6 discusses multilayer MDP LEDs using a sigma-conjugated polymer, polymethylphenylsilane (PMPS), in combination with Alq. Although PMPS is a known trap-free charge transport polymer with high charge mobility, the corresponding device properties are no better than those based on the low mobility PVK. Other problems associated with PMPS are its unavailability and photoinstability. Chapter 10 by J. Kido reports both single layer and multilayer LED structures with white light emission, with emphasis on the MDP approach. Chapter 12 focuses on single layer, full color MDP LEDs using PVK and an oxadiazole containing polymer. Chapter 14 demonstrates the combination of spin and dip coating for the fabrication of multilayer EL devices using PVK and also discloses three interesting device structures. These include novel liquid EL cells using various organic solvents containing active small molecules, novel discharge type EL cells using charged gas for electron injection, and EL devices having co-evaporated metal-Alq cathodes.

Chapters 7, 8, 9, 11 and 13 deal mainly with evaporated molecular OLEDs. As reported in Chapter 7, the highly complex PL and EL properties of C60 have been associated with a wide range of possible molecular packing resulting from the spherical C60 molecules with weak intermolecular interaction. If this is the case, a polymer C60 material may show improved PL and EL properties. Chapter 8 presents prototypical TPD/Alq OLEDs with Alq layers doped by electron transport emitters as well as those with starburst triarylamine molecules as the anode modification layer. Depending on the electron transport emitters, full color OLED can be designed and the triarylamine improves device performance and stability. Chapter 9 is a short review paper on the work by the Sanyo group on several Alq-like metal chelates, Zn porphyrin and heavy metal complexes. This group has been most noted for its work on highly stable OLEDs based on rubrene-doped hole transport layer. Chapter 11 by Hitachi's T. Nakayama on OLEDs with microcavity structures is an excellent review article on the subject matter. Chapter 13 by the Princeton group is an excellent review article on the electronic processes of TPD/Alq devices.

In summary, this book gives equal emphasis on molecular, polymer, and the hybrid MDP systems and is recommended for those who are involved in the area of organic electroactive materials and devices. However, its high price ($180) and its heavy weight (about 3 lbs., due to the use of heavy paper) are two major drawbacks.

Bing R. Hsieh
Xerox Webster Research Center
800 Philips Road
Webster, New York 14580