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Editorial

Organic Semiconductors: Past, Present and Future

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1. Introduction

Organic electronics, such as displays, photovoltaics and electronics circuits and components, offer several advantages over the conventional inorganic-based electronics because they are inexpensive, flexible, unbreakable, optically transparent, lightweight and have low power consumption. In particular, organic displays exhibit high brightness, fast response time, wide viewing angle, and low operating voltage.

The past few years have seen a significant and rapid growth of research and development of OSC and Organic Field Effect Transistor (OFET) devices, with promising results [1–3] and diverse range of applications. Organic Field Effect Transistors and Organic Light Emitting Diodes (OLEDs) are the fundamental electronic building blocks of organic electronic circuits. Every display has millions of transistors used for switching the pixels on/off. OFETs are used in displays, human-machine interfaces, electronic artificial skin, and smart digital gadgets. OFETs have been successfully employed in e-inks. One of the main technological advantages of OFET is that all the layers of an OFET can be fabricated and patterned at room temperature by a combination of low-cost solution processing and direct-write printing.

One very exciting prospect of developing devices based on organic materials is the power savings in OLED displays compared to back-light LCDs and plasma displays. Enhancement in applications and the miniaturization of electronics has led to the exploration of many advanced materials including quantum dots [4], organic molecules [5], carbon nanotubes [6], nanowires [7], and single atoms [8] or molecules [9–12].

2. The Present Issue

This special issue consists of 13 papers especially covering many important topics including seven reviews in the field of organic semiconductors; Organic Semiconductors [13,14], material fabrication and properties [15–18], OFET [19,20], Sensor [19], OLED [21,22], solar Cells [23,24], Transport Property [17], and Bio-organic electronics [25].

The properties of organic material in strong coupling with plasmon, and delocalized and localized plasmon coupled to aggregated dyes and the material properties in strong coupling is described in [13]. The design constraints of OLEDs and OPDs required to achieve fully organic electronic optical bio-detection systems and lab-on-a-chip (LoC) technologies is described in manuscript [14]. The charge transport properties of materials are critical to optimize organic electronic devices. The importance of charge transport layers in the development of inverted bulk heterojunction polymer solar cells is the focus of [24] and the intrinsic bulk electron-phonon interaction and the behavior of mobility in the coherent regime of many systems, such as naphthalene, rubrene, and pentacene, is the focus of [17]. Properties of materials that can be used organic semiconductors are reported in references [15–18].

An overview of OFET-based biosensors, pressure sensors and e-nose/vapour sensors is presented in [19]. The charge transport properties of dinaphtho[2,3-*b*:2',3'-*f*]thieno[3,2-*b*]thiophene single crystals in OFET is studied and its nonmonotonic pressure response is demonstrated [20]. The review "Emerging Transparent Conducting Electrodes for Organic Light Emitting Diodes" focuses on the emerging alternative transparent conducting electrodes materials for OLED applications, including carbon nanotubes, metallic nanowires, conductive polymers, and graphene [21]. Improvement in the lifetime of organic photovoltaic cells by using MoO3 in conjunction with tris-(8-hydroxyquinoline) aluminum as a cathode buffer layer is analysed [22]. The concept of bandgap science of organic semiconductor films for use in photovoltaic cells, charge control by doping and design of the built-in potential based on precisely-evaluated doping parameters is summarized in the manuscript [23]. The use of electron and hole transport layers in the inverted bulk heterojunction polymer solar cells is the goal of the article [24].

Bio-electronic devices can be used for developing OLEDs, OFETs and organic solar cells and such components have many advantages especially the biodegradable property. The potential opportunities of bio-organic electronics are reviewed in [25].

3. Future

New applications are likely to be in areas of biomedicine, lab-on-a-chip biomedical application, optics, OFETs, OLEDs, displays, information technology, smartcards/RFID tags, and sensors for environmental monitoring. The organic electronic devices will be very promising in niche applications, especially due to the cheap manufacturing cost, flexibility, and ease to integrate with other systems. OFETs prove to be important in applications ranging from sophisticated medical diagnostics to "smart" clothes that can display changing images. OFET-based sensors have many advantages over other types of sensors, such as signal amplification, high sensitivity, ease of fabrication, and miniaturisation for multisensory arrays. Organic semiconductors can interact with different chemicals and it is possible to convert the chemical information to electronic information, creating an "electronic nose".

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Conflicts of Interest

The author declares no conflicts of interest.

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