Preface—from crystals to films, and films to devices

The papers collected in this volume are those presented at the second Materials Chemistry Discussion which was held at Nottingham University, September 13–15, 1999. The meeting followed the format pioneered in Faraday Discussions in which the papers are preprinted and circulated to all those attending. Authors presented only the highlights, the bulk of the time being allocated to discussion. However, unlike the Faraday Discussions, the discussion was tape recorded and a summary is included at the end of the volume. The task of rapporteur was kindly undertaken by Dr John Wright (University of Kent) who performed a very difficult task with great skill.

It is just over 50 years since the observation by Eley (UK) and Vartanian (USSR) that highly conjugated organic materials are electronic semiconductors, which stimulated an immense amount of research activity. Initially the emphasis was on fundamental studies on zone refined single crystals of anthracene and related polycyclic aromatic hydrocarbons. It soon became clear that, as a consequence of their low carrier mobility, organics were unlikely to replace silicon in existing devices and the future lay in the synthesis of materials that could perform novel functions. Such materials do not generally yield crystals of the size and quality for device fabrication, so the emphasis shifted to film forming materials.

This volume illustrates the diversity of materials, properties and potential applications of organic thin films and shows just how far the subject has progressed in half a century. Shirota's review illustrates the major contribution that organic synthesis has made to the field. Indeed, almost all the important device materials are relatively new. The most important exceptions are the phthalocyanines (the materials chosen with great foresight by both Eley and Vartanian), which because of their stability, electronic properties, and opportunities for structural modification, remain of considerable importance (as illustrated by the papers given by Iwamoto, McKeown and Russell). Metzger discusses a molecule which acts as a unimolecular rectifier, and Gittins reports a hybrid organic/inorganic material which displays a diode effect. Polymeric materials are considered as device materials by Schweiger, Taylor, Wright, Hillman and Sferrazza.

Interest in ordered films arises from the need to maximise mobility and anisotropy of properties as well to satisfy the symmetry requirements for second harmonic generation. Langmuir–Blodgett films are employed in the work reported by Ashwell, P. V. Wright and Petty; epitaxy in the papers by Quintel and Ziegler; and self-assembly in the papers by Russell, McKeown, Leggett and Willis. Shirota's work suggests that if a highly ordered, oriented film is unobtainable then an amorphous glass may have a higher mobility than a polycrystalline film.

Eley's original observation was motivated in part by interest in electron transport in biological systems, and biological materials remain of interest for incorporation in devices, as evidenced by the papers by Leggett, Lösche and Bartlett.

Photocopiers are probably the most commercially successful devices based on the electrical properties of organics. Electroluminescent panels (Sano and Petty) which are critically dependent on the electrode/organic interface (Sato and Willis) are just reaching the market place. Sensors (papers by J. D. Wright, Evans and Ray) also show great promise.

Progress towards devices over the last half century has been slow, but with the advent of commercially successful devices progress can be expected to accelerate. It can be confidently predicted that when a second Materials Chemistry Discussion is held on the topic of Organic Thin Films many major developments in both materials and devices will be reported and, of course, discussed in appropriate depth.

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