Editorial: Carbon Based Electronic Materials

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From a semimetal to a wide gap semiconductor, from atomically flat diamond-like carbon thin films to nanostructured clustered films, from spherical fullerenes to high aspect ratio nanotubes, and from small molecules to long chain polymers, carbon is unique amongst the elements of the periodic table in taking such a wide variety of forms with such different structural and electronic properties. It is this richness and diversity that makes carbon as an electronic material so fascinating and was the impetus for the publication of this special issue of the *Journal of Material Science: Materials in Electronics*. The wide variety of material systems that are studied is equally matched by the different experimental and computational techniques and approaches that are used and this is reflected in the contributions from some of the internationally leading groups from around the world.

At the outset the scene is set by the introduction of some of the figures of merit for a device oriented approach to the use of carbon as an electronic material. Both conjugated polymers and small molecules are discussed and the first paper concludes with some prospects for carbon nanotube based composites and the use of nanotubes in optical based devices such as photovoltaics devices and light emitting diodes. The second paper expands the discussion of the different bond hybridisations and in particular the role of disorder and how the clustering of the sp^2 phase affects the electronic properties and electron emission from diamond-like carbon thin films. Field emission from carbon-nanotube conjugate polymer composites is also discussed and charge transportation is discussed in terms of percolation through the disordered polymer network. An in-depth experimental and theoretical discussion of electron transport in thin films is the subject of the third paper where localisation effects in the bandtails are shown to be important.

From flat thin films to clustered carbon films, the fourth paper is a comprehensive discussion of nanostructured carbon produced from supersonic expansion. This paper presents a state of the art discussion of the synthesis, optical and electrical characteristics and possible future applications of clustered films. Staying with nanosized carbon, but moving to nanocrystalline diamond, the fifth paper discusses the growth and application to electron emission of sulphur containing nanocrystalline diamond. The paper discusses how the addition of sulphur results in modification of the sp^2 phase and how this influences the electron emission.

From ultrananocrystalline diamond to diamond itself, the sixth and seventh papers report on the use of computational methods to study diamond. The sixth paper describes some of the common impurities and impurity related defects that are of technological significance. An understanding of doping of diamond is crucial for diamond based electronics. Of equal importance is the role played by the surfaces of diamond in the origin of p-type conductivity. How fullerenes affect the doping on different terminated diamond surfaces is the subject of the seventh paper.

Finally, an understanding of transport and the role that defects and degradation play in limiting potential devices are discussed in the final two papers of the special issue. Khan and colleagues describe the importance of charge balance and device lifetime in organic light emitting diodes as well as providing a viewpoint on the commercialisation of these materials for displays. The final paper deals with carrier transport in carbon nanotubes and how the intentionally incorporation of defects gives an unique opportunity to understand the factors that influence conduction.

Clearly an intense international effort is on going in the many different fields for which this special issue is just a snapshot of high quality international leading research. It is therefore personal a pleasure for me to thank all the authors who have taken considerable time in putting together their papers. In addition, I would like to thank the Editor of the Journal of Materials Science: Materials in Electronics, Arthur Willoughby, for his help advice and to all those involve in the publishing of the special issue. I hope the reader will find the papers contained in the special issue to be of use and demonstrates the richness of carbon based electronic materials.

Guest Editor

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