Thin films of molecular organic materials

2008 J. Phys.: Condens. Matter 20 180301

(http://iopscience.iop.org/0953-8984/20/18/180301)

J. Phys.: Condens. Matter **20** (2008) 180301 (2pp) doi:10.1088/0953-8984/20/18/180301

PREFACE

Thin films of molecular organic materials

Guest Editor

J Fraxedas
Centre d' Investigacióen Nanociència i Nanotecnologia (CIN2-CSIC-ICN), Spain

This special issue is devoted to thin films of molecular organic materials and its aim is to assemble numerous different aspects of this topic in order to reach a wide scientific audience. Under the term 'thin films', structures with thicknesses spanning from one monolayer or less up to several micrometers are included. In order to narrow down this relaxed definition (how thin is thin?) I suggest joining the stream that makes a distinction according to the length scale involved, separating nanometer-thick films from micrometer-thick films.

While the physical properties of micrometer-thick films tend to mimic those of bulk materials, in the low nanometer regime new structures (e.g., crystallographic and substrate-induced phases) and properties are found. However, one has to bear in mind that some properties of micrometer-thick films are really confined to the film/substrate interface (e.g. charge injection), and are thus of nanometer nature. Supported in this dimensionality framework, this issue covers the most ideal and model 0D case, a single molecule on a surface, through to the more application-oriented 3D case, placing special emphasis on the fascinating 2D domain that is monolayer assembly. Thus, many aspects will be reviewed, such as single molecules, self-organization, monolayer regime, chirality, growth, physical properties and applications. This issue has been intentionally restricted to small molecules, thus leaving out polymers and biomolecules, because for small molecules it is easier to establish structure–property relationships.

Traditionally, the preparation of thin films of molecular organic materials has been considered as a secondary, lower-ranked part of the more general field of this class of materials. The coating of diverse surfaces such as silicon, inorganic and organic single crystals, chemically modified substrates, polymers, etc., with interesting molecules was driven by the potential applications of such molecular materials/substrate systems (also called heterostructures) based on the physical properties of the bulk materials, usually in the form of single crystals. However, in recent years the thin films community has been continually growing, helping the field to mature. In my opinion two main aspects have advanced the thin molecular films field. The first is the different applications with optical and electrical devices such as OFETs (organic field-effect transistors) and OLEDs (organic light emitting diodes), applications that could not have been achieved with single crystals because of limited size, difficult processability and mechanical fragility. The second is the involvement of the surface science community with their overwhelming arsenal of experimental techniques.

From the synthesis point of view, the preparation of thin films is being regarded as a complementary synthesis route. The different externally accessible variables involved in the preparation process (temperature, pressure, molecular flux, distance, time, concentration, solvent, substrate, etc.), which define the so-called parameter hyperspace, can be so diverse when comparing competing synthesis routes (e.g. solution versus vapour growth) that we should not be surprised if different crystallographic phases with different morphologies are obtained, even if metastable. We should not forget here that the amazingly large number of available molecules is due to the longstanding and innovative work of synthesis chemists, a task that has not been sufficiently recognized (laymen in the domain of synthesis of organic molecules tend to believe that almost any molecule can be synthesized).

In summary, one of the goals of this issue is to highlight the emerging importance of the field of thin molecular organic films by giving selected examples. It is clear that some important examples are missing, which are due in part to space limitation and to the understandable reluctance of highly-ranked specialists to contribute because of work overload. Among these not included but not forgotten subjects we can list films showing linear and non-linear optical properties (e.g. OLEDs), the always fascinating world of polymorphism, films involving small molecules of biological interest such as aminoacids and nucleic acids, nanopatterning, growth in zero gravity, etc. I have no doubt that contributions on such subjects deserve to be collected in a future special issue.