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TECHNICAL SPECIFICATION

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Nanomanufacturing – Key control characteristics –
Part 5-3: Thin-film organic/nano electronic devices – Measurements of charge carrier concentration

INTERNATIONAL
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FOREWORD

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62607-5-3, which is a Technical Specification, has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
113/477/DTS	113/523/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC TS 62607 series, published under the general title *Nanomanufacturing – Key control characteristics*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Organic/nano thin-film devices are attracting much attention as promising candidates for light, low cost, flexible, and printable devices in large-area electronics applications. Recently, charge carrier doping techniques have been intensely studied and developed, in the same way as the mature silicon technologies. In organic light-emitting diodes (OLEDs) and organic thin-film transistors (OTFTs), which are typical organic/nano thin-film devices, carrier doping around contact electrode regions with molecular donor/acceptor dopants are often utilized to make ohmic-like contacts for the purpose of increasing electric current in the devices. While the great importance of carrier doping in organic/nano layers is well recognized, the carrier doping mechanisms have not been fully understood yet, and the evaluation method of charge carrier concentration in these materials has not been established.

Conventional representative methods for evaluating charge carrier concentrations (or dopant concentrations) and the type of charge carrier (electron or hole) in inorganic semiconductor materials are Hall-effect measurements and capacitance-voltage measurements. For example, the Hall-effect measurement based on the van der Pauw configuration enables one to get the above-mentioned physical parameters of the charge carrier in specimens with arbitrary shapes including thin-film structures. However, this versatile method cannot be utilized for higher resistance materials such as low-mobility organic semiconductors because of lower currents and sensitivities in the Hall effect. At the present time, the capacitance-voltage measurement based on metal/insulator/semiconductor structures is not applicable to highly-doped organic semiconductors that show some level of metallic behaviour. Therefore, standard methods and guidelines for measuring charge carrier concentration in organic semiconductor layers need to be developed.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 5-3: Thin-film organic/nano electronic devices – Measurements of charge carrier concentration

1 Scope

This part of IEC TS 62607, which is a Technical Specification, specifies sample structures for evaluating a wide range of charge carrier concentration in organic/nano materials. This specification is provided for both capacitance-voltage (C-V) measurements in metal/insulator/semiconductor stacking structures and Hall-effect measurements with the van der Pauw configuration. Criteria for choosing measurement methods of charge carrier concentration in organic semiconductor layers are also given in this document.

2 Normative references

There are no normative references in this document.