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TECHNICAL SPECIFICATION

Nanomanufacturing - Key control characteristics -
Part 3-5: Nanophotonic products - Light conversion efficiency of quantum dot enabled light conversion films: luminance meter

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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

Draft	Report on voting
113/957/DTS	113/986/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

This document specifies how to measure the light conversion efficiency, which is one of key control characteristics of quantum dot enabled light conversion films (Q-LCFs).

Quantum dot (QD) is a kind of representative nanomaterial, has typical quantum confinement effects and exhibits distinct size-dependent properties, that is, the luminescence peak is adjustable with the QD size. QDs have broad absorption spectra, as the absorption edge is continuous for all wavelengths shorter than the absorption edge. They are also known for narrow emission spectra – a trait that arises when QDs are consistent in both size and composition. Using the same excitation source, commonly blue light-emitting diode, to excite quantum dots of different particle sizes, QDs of different particle sizes can emit spectra with different peak wavelengths which are larger than the excitation wavelength. Based on the above unique characteristics, Q-LCFs are used in display products, greatly improving the colour gamut. Currently Q-LCFs are widely adopted by television makers (manufacturers, suppliers, etc.) to add a new feature to liquid crystal displays.

Although they have such advantageous features, quantum dots are sensitive to water, oxygen, light, high temperature and so on. During the manufacturing process of Q-LCFs, various chemicals are used to form a solid matrix in which quantum dots are dispersed. After the quantum dots have been encapsulated in the films, water and oxygen still can pass through the polymer matrix and reach the quantum dots to a certain degree, depending on the barrier property of the matrix and encapsulation layer. During and after manufacturing, adverse effects, such as lowering of quantum efficiency and stability of quantum dots, will occur.

It is critical to measure quantum efficiency of quantum dots in Q-LCFs; however, measurement of this characteristic by integrating sphere is relatively complicated and of low test efficiency, the integrating sphere test has limitations, such as the sample size must be smaller than the size of the integrating sphere, and the luminance range of backlight is narrow. The light conversion efficiency (LCE) parameter is more meaningful than the quantum efficiency (QE) parameter in practical industrial applications, as the LED backlight usually has higher luminance. For measuring LCE, a luminance meter is used as the test tool, which only measures the number of photons within 2π steradian directly in front of the backlight after excitation of the sample. This is significantly less than the number of photons collected by the integrating sphere. So the light conversion efficiency (LCE) measured by this document is directly related to the luminance actually detected in the display industry, whereas the quantum efficiency is not. It is for this reason that LCE, a more straightforward characteristic, is measured instead. Brighter Q-LCFs correlate with higher quantum efficiency of the quantum dots inside the film.

These characteristics will enable supplier and purchaser of Q-LCFs to determine rapidly whether the quantum dots are stable and of high quantum efficiency in the matrix, or whether the quantum dots and matrix are matched, or whether the Q-LCFs satisfy the luminance and lifetime requirements, by using common equipment to test.

For predictable and reproducible results to be used in diversified situations, it is essential for characteristics to be described and assessed in a standardized manner and to standardize the methods for quality control of the manufacturing processes.

This document can also apply to other quantum dot conversion members such as quantum dot diffusing plate.

1 Scope

WARNING – Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

This part of IEC 62607 establishes a standardized method to determine the optical key control characteristic

– light conversion efficiency

for quantum dot enabled light conversion films (Q-LCFs) by

– luminance meter.

The light conversion efficiency is derived by the photoluminescence spectrum.

The typical application areas of this standardized measurement method are the nano-photoelectric display devices using Q-LCF as key component, and other relevant optical conversion devices.

2 Normative references

There are no normative references in this document.

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1 Withdrawn.