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Nanomanufacturing – Key control characteristics – Part 3-3: Luminescent nanomaterials – Determination of fluorescence lifetime of semiconductor quantum dots using time correlated single photon counting (TCSPC)

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

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

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

Enquiry draft	Report on voting
113/490/DTS	113/529/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 document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Fluorescence lifetime is considered as the average time that luminescent materials spend in the excited state before emitting a photon and returning to the ground state. Fluorescence lifetime can vary widely from picoseconds to hundreds of nanoseconds, even to microseconds or milliseconds, depending on the type of luminescent nanomaterials.

Fluorescence lifetime is an important property of luminescent materials. Fluorescence lifetime does not depend on fluorophore concentration, absorption by the sample, thickness of the sample, method of measurement, fluorescence intensity, photo-bleaching, and/or excitation intensity. It is affected by external factors, such as temperature, polarity of solvent, and the presence of fluorescence quenchers. Fluorescence lifetime is sensitive to internal factors that are dependent on fluorophore structure.

The possible applications of measuring fluorescence lifetime include the following:

a) determine the environment that the sample molecules inhabit, e.g. viscosity, pH value, temperature, polarity, and solvation, etc.;

b) uncover the size and shape of the sample molecules, and the distances between different parts of the molecules;

c) learn about the contributions of each component in a mixture of sample molecules, through time-resolved spectra of overlapping emissions;

d) reveal the molecular interactions;

e) obtain the kinetic and dynamic rates.

Time-correlated single photon counting (TCSPC) is a widely used, sensitive, reproducible and precise technique to measure the photon arrival time in applications characterized by a strong demand in terms of temporal resolution such as fluorescence lifetime spectroscopy and imaging, photon migration and time of flight measurements.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 3-3: Luminescent nanomaterials – Determination of fluorescence lifetime of semiconductor quantum dots using time correlated single photon counting (TCSPC)

1 Scope

This part of IEC 62607, which is a Technical Specification, provides a method for determining the fluorescence lifetime of semiconductor quantum dots (QDs) using the time correlated single photon counting (TCSPC) technique. TCSPC is suitable for testing fluorescence lifetime in the range from picoseconds to nanoseconds. This document is only applicable to liquid samples that are stable dispersions of QDs. It is not applicable to solid samples.

This document includes:

– outlines of the experimental procedures,
– data processing, and
– case study.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696, *Water for analytical laboratory use – Specification and test methods*

ISO 385, *Laboratory glassware – Burettes*

ISO 648, *Laboratory glassware – Single-volume pipettes*

ISO 1042, *Laboratory glassware – One-mark volumetric flasks*