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Nanomanufacturing - Key control characteristics -
Part 4-10: Nano-enabled energy storage - Electrochemical characteristics of carbon nanomaterial for the electrodes of electric double-layer capacitors: coin cell method

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IEC TS 62607-4-10 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
113/959/DTS	113/983/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– withdrawn, or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

Electrochemical capacitors are widely used in electric vehicles, high-speed trains, aviation, photovoltaics, wind power and electronics, due to their ultra-fast charge/discharge capability, long cycle life, wide working temperature range, high safety and reliability and low maintenance costs.

Electric double-layer capacitors (EDLCs) are a category of the electrochemical capacitors. The mechanism of energy storage for EDLCs relies on reversible ion adsorption at the interface between the active material and electrolyte. Therefore, materials with a large specific surface area - such as nanoporous carbon materials - are commonly employed as active materials in EDLCs. Additionally, to enhance electrode conductivity, high-conductivity materials (e.g. carbon black, graphene, and carbon nanotubes/CNTs) serve as conductive agents in EDLCs. Thus, carbon nanomaterials play an irreplaceable and critical role in EDLCs, directly determining their electrochemical performance.

The electrochemical performance of the carbon nanomaterial used in EDLC is evaluated using the assembled device, like coin-type EDLCs, three-electrode EDLC cells or cylindrical EDLC cells. Coin-cell-based characterization offers advantages including low cost, versatility, and high efficiency, making it widely used in both academic and industrial settings.

This document introduces standard methods to determine the electrochemical key control characteristics of the carbon nanomaterial based on the coin-type EDLCs.

1 Scope

This part of IEC TS 62607 establishes standardized methods to determine the electrochemical key control characteristics, including:

– specific capacitance, voltage maintenance rate, endurance in cycling and temperature endurance of carbon nanomaterials by determining the standard coin-type EDLC.

The electrochemical key control characteristics are derived by calculating the recording curve at the specific charging and discharging process.

– The document is applicable for coin-type EDLC assembled from carbon nanomaterials, such as nanoporous activated carbon, carbon aerogel, carbon nanotube, carbon black, graphene, nano graphite sheet, vapor-grown carbon fibre and so on.
– Typical application areas of this method are research, manufacturer and downstream use to guide material processing and quality control.

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.

IEC TS 62565-5-1:2023, *Nanomanufacturing - Product specifications - Part 5-1: Nanoporous activated carbon - Blank detail specification: Electrochemical capacitor*

IEC TS 62607-4-9, *Nanomanufacturing - Key control characteristics - Part 4-9: Nano-enabled energy storage - Electrochemical characteristics of carbon nanomaterial for the electrodes of electric double layer capacitors (EDLC): Coin cell preparation*

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IEC 60050-482:2004, *International Electrotechnical Vocabulary (IEV) - Part 482: Primary and secondary cells and batteries*

IEC 62391-1:2022, *Fixed electric double-layer capacitors for use in electric and electronic equipment - Part 1: Generic specification*

IEC TS 62565-5-2:2022, *Nanomanufacturing - Material specifications - Part 5-2: Nano-enabled electrodes of electrochemical capacitors - Blank detail specification*

IEC 62576:2018, *Electric double-layer capacitors for use in hybrid electric vehicles - Test methods for electrical characteristics*

ISO 18300:2016, *Electrically propelled vehicles - Test specifications for lithium-ion battery systems combined with lead acid battery or capacitor*