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Nanotechnologies - Electron spin resonance (ESR) as a method for measuring reactive oxygen species (ROS) generated by metal oxide nanomaterials

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foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part 1.Structure and Drafting Rules of Standardization Documents"

drafted.

This document is equivalent to ISO /T S18827.2017 "Nanotechnology Electron Spin Resonance (ESR) method for the detection of metal oxide nanomaterials

Reactive Oxygen Species (ROS) produced by feedstocks. The file type is adjusted from ISO technical specifications to my country's national standards.

The following minimal editorial changes have been made to this document.

--- References reordered.

Please note that some content of this document may be patented. The issuing agency of this document assumes no responsibility for identifying patents.

Introduction

In recent years, the application of metal and metal oxide nanomaterials in biomedicine and industry has increased dramatically. However, most man-made nano

The scientific rationale for the cytotoxicity and genotoxicity of materials is not fully understood. The production of reactive oxygen species (ROS) is an important aspect of nanotoxicity

mechanism. The research on the harmful effects of metal oxide nanomaterials is still in its infancy. ROS-generating ability is the result of metal oxide nanomaterials

one of the main sources of toxicity. Excessive ROS can cause oxidative stress, resulting in

the inability of cells to maintain normal physiological redox regulation functions.

It can lead to DNA damage, dysregulation of cell signaling pathways, changes in cell migration, cytotoxicity, apoptosis and tumorigenesis.

The generation of ROS depends on many key factors, including size, shape, particle surface, positive surface charge, surface functional groups, particle solubility,

Metal ions released from nanometals and nanometal oxides, UV light activation, aggregation, mode of action with cells, inflammation, and mediator interactions

pH[4]. Therefore, in order to detect and quantify ROS generated on the surface of metal oxide nanomaterials, electron spin resonance is proposed in this paper.

(ESR) method.

Among ROS, the most biologically relevant and widely studied are hydroxyl radical (OH), superoxide anion (O2-), singlet

Oxygen (1O2) and hydrogen peroxide (H2O2).

However, it is very difficult or impossible to directly detect some free radicals (such as superoxide anion and hydroxyl radicals) in solution at room temperature

of [5]. The ESR spin trapping technique is a very useful tool to study transient free radicals [6]. developed in the late 1960s

Spin trapping technology uses nitrones or nitro compounds (spin trapping agents) to react with target free radicals to form stable and identifiable free radicals.

base (spin adduct), and then use ESR spectrometer to detect a technique.

Spin adducts can be directly detected by ESR spectrometers. The ESR spectra of spin adducts are specific and can provide ROS presence

fingerprint characteristics.

This document specifies the detection of 5,5-dimethyl-1-pyrroline-N-oxide (DMPO) produced by metal oxide nanomaterials using ESR

and adducts of hydroxyl radicals, 5-tert-butoxycarbonyl-5-methyl-1-pyrroline-N-oxide (BMPO) and superoxide anions, to

and a method for the adduct of 2,2,5,5-tetramethyl-3-pyrroline-3-carbamide (TPC) and singlet oxygen. This document provides a

Methods for assessing ROS production from metal oxide nanomaterials in a cellular environment. The method may be in the evaluation stage of physicochemical properties and has not been carried out yet.

Cytotoxicity tests of nanomaterials that provide valuable predictive information on

ROS-mediated cytotoxicity.

Nanotechnology Electron Spin Resonance (ESR)

detection of metal oxide nanomaterials

Generated reactive oxygen species (ROS)

1 Scope

This document describes a method for detecting reactive oxygen species generated from metal oxide nanomaterials in aqueous solution using electron spin resonance (ESR).

(ROS)(.OH, O2- and 1O2).

This document does not apply to ESR detection methods that do not use ROS-specific spin traps.

2 Normative references

There are no normative references in this document.

3.1 Terms and Definitions

The following terms and definitions apply to this document.

3.1.1

nanomaterial

Any material whose external dimension, internal or surface structure is on the nanoscale.

Note 1.This generic term includes nano-objects and nano-structured materials.

Note 2.See ISO /T S80004-1.2015, 2.8-2.10.

[Source. ISO /T S80004-1.2015, 2.4]

3.1.2

test sample testsample

Materials, devices, parts of devices, components, extracts or parts thereof for use in biological testing, chemical testing or evaluation.

[Source. GB/T 16886.5-2017, 3.5]

3.1.3

zero baseline control zerobaselinecontrol

Equivalent to a positive control when no free radicals are detected.

Note. For example, the zero baseline control of the Fenton reaction positive control is a mixed solution of iron-free H2O2 and DMPO; hypoxanthine-xanthine oxidase (HX-

XO) system is hypoxanthine and BMPO without HX-XO; Bengal red photosensitization system is Bengal red and TPC without light conditions.

3.1.4

positive control positivecontrol

Well-characterized materials and/or substances. The material and/or substance, when used in the evaluation of a specified test method, demonstrates that the test procedure

The sequence is suitable for obtaining a reproducible, appropriately positive or reactive response in the test system.

[Source. GB/T 16886.12-2017, 3.12]

3.2 Abbreviations

The following abbreviations apply to this document.