



BSI Standards Publication

Nanotechnologies — Assessment of peroxidase-like activity of metal and metal oxide nanoparticles

National foreword

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*Nanotechnologies — Evaluation de l'activité de type peroxidase des
nanoparticules métalliques et d'oxydes métalliques*





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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	2
4 Principle	2
5 Physicochemical characterization of metal or metal oxide NPs	3
6 Apparatus and reagents	4
6.1 Apparatus and appliances	4
6.1.1 Spectrophotometer	4
6.1.4 Thermostatic water bath	4
6.2 Reagents	4
7 Solution preparation	5
7.1 General requirements	5
7.2 TMB solution	5
7.3 Buffer solution	5
7.4 Nanoparticle dispersion solution	5
7.5 Additional control solution	5
8 Measurement procedure	5
8.1 Measurement condition	5
8.2 Measurement procedure	6
8.3 Measurement of reagent blank absorption	7
8.4 Positive control measurement	7
8.5 Additional control measurement	7
9 Data analysis	7
10 Measurement uncertainties	8
11 Test report	9
Annex A (informative) Measurement for the mass from the tested metal and metal oxide nanoparticles	10
Annex B (informative) Example of calculation and uncertainty evaluation from the peroxidase-like activity of iron oxide nanoparticles	11
Bibliography	16

Foreword

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This document was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

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Introduction

Enzymes are the biological catalysts that control biochemical reactions. The enzyme peroxidase is a metalloenzyme with many isoforms. It catalyses the oxidation of various organic substrates by hydrogen peroxide, which is used extensively in biochemistry applications. Metal and metal oxide nanoparticles have a wide range of applications in biomedicine, environment protection, and some other fields, such as magnetic separation, detection, anti-bacterial, degradation of contaminants, medical imaging and tumour therapy. In recent years, an intrinsic peroxidase-like activity was observed in some metal and metal oxide nanoparticles, which means that these metal and metal oxide nanoparticles can catalyse the oxidation of substrates of natural peroxidase by hydrogen peroxide under mild reaction conditions in comparable efficiency and kinetics. Iron oxide (Fe_3O_4) nanoparticles are one representative material, and cobalt oxide (Co_3O_4) nanoparticles, copper oxide (CuO) nanoparticles, manganese oxide (MnO_2) nanoparticles, vanadium oxide (V_2O_5) nanoparticles, gold (Au) nanoparticles and platinum (Pt) nanoparticles have been reported to have the peroxidase-like activity as well. These findings extend enzyme mimics from organic compounds to inorganic nanomaterials.

Certain metal and metal oxide nanoparticles can catalyse the transfer of electrons from H_2O_2 to colorimetric indicator under physiological condition. This phenomenon is like the colorimetric reaction mediated by peroxidase and thus is called as peroxidase-like catalysis. Such catalytic property can be used to produce colorimetric, chemiluminescent or electrochemical signals which have great potential applications in biosensors, electrochemical sensors and immunoassays. The nanoparticles with peroxidase-like activity may have anti-tumour, antibacterial or antioxidant functions in biological system. In addition, the nanoparticles with such activity can have potential impacts on health, safety and the environment. Therefore, it is important to assess the peroxidase-like activity of a nanoparticle in practical applications.

The peroxidase-like activity of nanoparticles strongly depends on multiple factors including the composition, size, surface chemistry and crystal structure of the nanoparticles, as well as the measurement conditions. Therefore, it is important to establish a standard method for assessing the peroxidase-like activity of metal and metal oxide nanoparticles.

This document provides a specification for the assessment of peroxidase-like activity of metal and metal oxide nanoparticles. This protocol is useful to enterprises, research laboratories or institutions and metrological organizations that are working on nanomaterials used in biomedical applications and environment protection.

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