# ISO/TR 23463:2022-05 (E)

## Nanotechnologies - Characterization of carbon nanotube and carbon nanofibre aerosols to be used in inhalation toxicity tests

## Contents

Page


Foreword ..... iv

Introduction ..... v

1 Scope ..... 1

2 Normative references ..... 1

3 Terms and definitions ..... 1

4 Abbreviated terms ..... 8

5 Considerations in CNT and CNF inhalation studies ..... 8
5.1 General ..... 8
5.2 Workplace exposure scenario ..... 8
5.3 Existing inhalation toxicity testing guidelines ..... 9

6 Physicochemical parameters related to the toxicity of CNTs and CNFs ..... 9
6.1 General ..... 9
6.2 Aerodynamic properties of aerosols for deposition of fibres ..... 9
6.3 Size and shape (including length, width, aspect ratio, state of aggregation/ agglomeration, and rigidity) ..... 10
6.4 Specific surface area ..... 11
6.5 Crystalline structure and defects ..... 11
6.6 Surface chemistry, functionalization, surface charge, impurities, and radical generation/scavenging potential ..... 11
6.7 Biodurability ..... 12

7 Issues for the characterization of CNT and CNF aerosols ..... 12
7.1 General ..... 12
7.2 Characterization of physicochemical properties of CNT and CNF prior to aerosol generation ..... 13
7.2.1 General ..... 13
7.2.2 Size and size distribution ..... 13
7.2.3 Shape (rigidity and agglomeration/aggregation) ..... 14
7.2.4 Surface area ..... 14
7.2.5 Crystalline structures ..... 14
7.2.6 Surface chemistry, functionalization, surface charge, and radical generation/scavenging potential ..... 14
7.2.7 Composition, purity, and impurities ..... 14
7.2.8 Biodurability (in vivo and in vitro tests) ..... 15
7.3 CNT and CNF aerosol characterization (sampling and measurement) ..... 15
7.3.1 General ..... 15
7.3.2 Size and size distribution of CNT and CNF aerosols ..... 16
7.3.3 The shape of CNT and CNF aerosols ..... 18
7.3.4 Crystalline structure and defects ..... 18
7.3.5 Surface chemistry ..... 18
7.3.6 Composition analysis ..... 19
7.3.7 Fibre density ..... 19
7.3.8 Concentration ..... 19
7.4 Direct and indirect measurement ..... 20

7.4.1 Direct measurement ..... 20
7.4.2 Indirect measurement ..... 21

Annex A (informative) Physicochemical properties of CNT associated with biological activity ..... 22

Annex B (informative) CNT and CNF aerosol monitoring instruments ..... 23

Bibliography ..... 26