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BSI Standards Publication

Fine bubble technology — General principles for usage and measurement of fine bubbles

Part 1: Terminology

National foreword

This British Standard is the UK implementation of ISO 20480-1:2017.

The UK participation in its preparation was entrusted to Technical Committee LBI/50, Fine Bubble Technology (FBT).

A list of organizations represented on this committee can be obtained on request to its secretary.

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Fine bubble technology — General principles for usage and measurement of fine bubbles —

Part 1: **Terminology**

Technologie des fines bulles — Principes généraux pour l'utilisation et la mesure des fines bulles —

Partie 1: Terminologie

Reference number
ISO 20480-1:2017(E)

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Foreword

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This document was prepared by ISO/TC 281, *Fine bubble technology*.

A list of all the parts in the ISO 20480 series can be found on the ISO website.

Introduction

Applications of fine bubble technologies can be found in cleaning, environmental improvement, the food and drink sector, aeration systems, medicine, water and waste water treatment, as well as agriculture and aquaculture. Developing appropriate terminology for such diverse technologies is therefore critical to business trade or product acceptance by consumers.

Fine bubbles can be present in both liquids and solids. Fine bubbles can contain air or another gas. The bubble can be held in place by surface tension or be surrounded with a coating, e.g. a lipid. Fine bubbles generated for various applications can vary in size, gas content or bubble coating. The generation techniques used are also different.

It should be noted that the motion of bubbles in a medium can be determined by buoyancy forces or randomly and thermally activated processes leading to Brownian motion. For this reason, larger bubbles can display buoyant behaviour (rise upwards) and smaller bubbles remain in the liquid medium displaying random motion. This document focuses on the definitions of such entities.

Fine bubble technology — General principles for usage and measurement of fine bubbles —

Part 1: Terminology

1 Scope

This document specifies terminology and definitions used in the area of fine bubble technology. Terminology in this document covers general principles, measurements, and individual applications of fine bubble technology.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
bubble
gas in a medium enclosed by an interface

3.2
fine bubble
bubble (3.1) with a *volume equivalent diameter* (3.8) of less than 100 µm

Note 1 to entry: 100 µm is also represented as 1×10^{-4} m.

Note 2 to entry: Annex A provides further information on the use of terms "fine bubble" or "*ultrafine bubble*" (3.3), instead of "nanobubble".

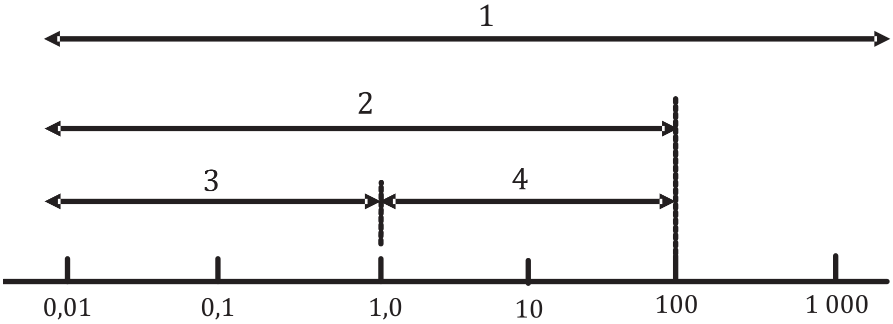
3.3
ultrafine bubble
fine bubble (3.2) with a *volume equivalent diameter* (3.8) of less than 1 µm

Note 1 to entry: Measured examples of ultrafine bubbles in water by particle characterization methods, in practical application fields, mostly range between 100 nm and 200 nm. The measured results can include contaminants, as well as ultrafine bubbles.

3.4
microbubble
fine bubble (3.2) with a *volume equivalent diameter* (3.8) in the range from equal or greater than 1 µm to less than 100 µm

Note 1 to entry: Figure 1 shows the size range of *bubbles* (3.1), fine bubbles, *ultrafine bubbles* (3.3), and microbubbles.

Dimensions in µm



Key

1 bubble

2 fine bubble

3 ultrafine bubble

4 microbubble

Figure 1 — Scale diagram showing bubble diameters

3.5
solid medium
material in solid phase in which *bubbles* (3.1) are dispersed

Note 1 to entry: A solid medium can be a congealed or chemically immobilized (solidified) liquid which contains bubbles. As a result, bubbles are immobilized or have a restricted degree of mobility.

3.6
liquid medium
material in liquid phase in which the *bubbles* (3.1) are dispersed

3.7
bubble number concentration
number of *bubbles* (3.1) per unit volume of medium

Note 1 to entry: The medium can be *solid medium* (3.5) or *liquid medium* (3.6).

3.8
volume equivalent diameter
d_{eq}
diameter of the spherical bubble of equivalent volume

$$d_{eq} = \sqrt[3]{\frac{6}{\pi} V_{bubble}}$$

where V_{bubble} is the volume of the considered bubble

3.9
bubble volume
spherical (or otherwise) volume of a *bubble* (3.1)

Note 1 to entry: In case of a bubble covered by its *bubble shell* (3.10), the volume of the bubble shell should be included.

3.10
bubble shell
object or a collection of objects that cover the *bubble* (3.1) surface almost completely

3.11
bubble temperature
temperature at which an infinitesimal amount of vapour is in equilibrium with a bulk liquid for a specified pressure

[SOURCE: ISO 20765-2:2015, 3.2, modified — Note 1 to entry and Note 2 to entry have been deleted.]

3.12
bubble-point pressure
pressure under which gas bubbles form in a liquid at a particular operating temperature which gas *bubbles* (3.1) form

[SOURCE: ISO 15156-2:2015, 3.2]

3.13
coalescence
action by which *bubbles* (3.1) in suspension unite to form larger bubbles

[SOURCE: ISO 29464:2011, 3.1.24, modified — "liquid particle" has been changed to "bubbles".]

3.14
bubble stability
duration for total volume of bubbles in dispersion to increase twofold or reduce by half under a given temperature and pressure conditions

3.15
bubble size stability
duration for a *volume equivalent diameter* (3.8) of a *bubble* (3.1) to increase twofold or reduce by half under given temperature and pressure conditions

3.16
bubble number stability
duration for the number of bubbles to increase twofold or reduce by half under a given temperature and pressure conditions

3.17
bubble generating system
system for creating *bubbles* (3.1) in *a liquid medium* (3.6)

3.18
fine bubble generating system
system for creating *fine bubbles* (3.2) in *a liquid medium* (3.6)

3.19
ultrafine bubble generating system
system for creating *ultrafine bubbles* (3.3) in *a liquid medium* (3.6)

3.20
number concentration index
quantity representing the concentration of objects in a fine bubble dispersion measured by an industrially available and agreed method

Note 1 to entry: Fine bubble dispersion in reality often contains not only fine bubbles but also other components with application-specific functions.

3.21
size index
quantity representing an object size in a fine bubble dispersion measured by an industrially available and agreed method

Note 1 to entry: Fine bubble dispersion in reality often contains not only fine bubbles but also other components with application-specific functions.

Annex A
(informative)

Use of the terms "fine bubble" or "ultrafine bubble", instead of "nanobubble" in ISO/TC 281 documents

ISO/TC 281 recognizes that the term "nanobubble" is commonly used to mean "ultrafine bubble". However, "nanobubble" is not defined clearly, and thus the use of "ultrafine bubble" is strongly preferred.

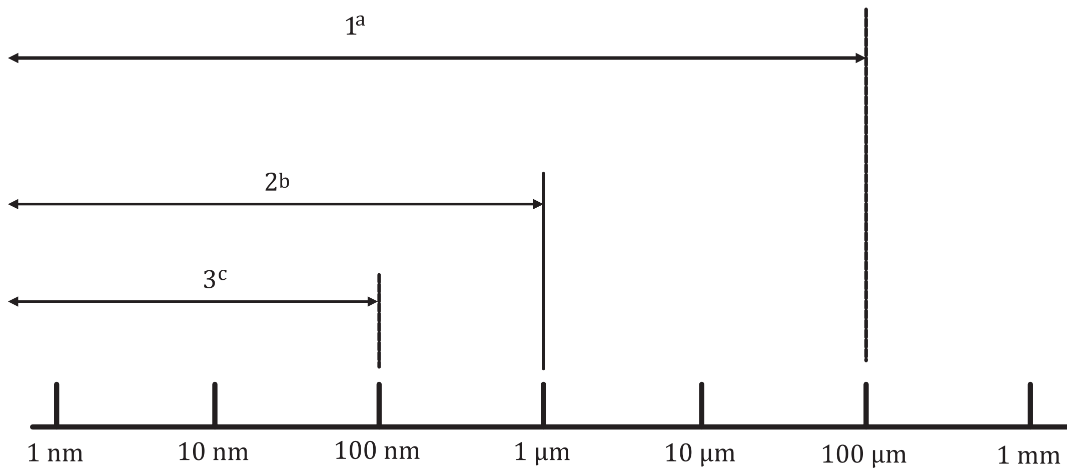
The measurement and characterization of ultrafine bubbles became possible comparatively recently. Ultrafine bubbles are not visible to the naked eye. ISO/TC 229 defines nano-objects as having a size less than 100 nm. Ultrafine bubbles are defined with the size range of 1 µm to a few nm. The smallest size of an ultrafine bubble depends upon the minimum number of molecules that can contain gas. Figure A.1 shows, with the straight line, the size range of nano-objects (including bubbles) specified in ISO/TS 80004-1. This indicates that their diameters are 100 nm or less.

Recent developments of measurement technology of nano scale have proven that there are very small invisible bubbles of some sizes, which are stationary in liquid for a long time. Such bubbles, which are the major subject of discussion in ISO/TC 281, range approximately from 100 nm to 200 nm in diameter, measured in water.

Although nano-objects are specified as 100 nm or less in ISO/TS 80004-1, there is no scientific or convincing evidence for the time being that there is a difference in physical phenomena of ultrafine bubbles with the dividing line of 100 nm.

Therefore, ISO/TC 281 does not use the term "nanobubble" throughout the fine bubble documents it develops, and instead uses "fine bubble" or "ultrafine bubble" in order to avoid confusion in the industry, the market, and in international standardization activities.

In ISO/TC 281 documents, the term "nanobubble" appears only in this particular annex as an exception for the purpose of explaining why ISO/TC 281 does not use this term.



Key

1 fine bubbles

2 ultrafine bubbles

3 nano-objects

a As specified by ISO/TC 281.

b Nanobubbles have sizes within the size range of ultrafine bubbles.

c Specified in ISO/TS 80004-1.

Figure A.1 — Size range of nano-objects of ultrafine bubbles and fine bubbles

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