



BSI Standards Publication

Nanotechnologies — Clay nanomaterials

Part 2: Specification of characteristics and measurements for
clay nanoplates used for gas-barrier film applications

National foreword

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Part 2: Specification of characteristics and measurements for clay nanoplates used for gas-barrier film applications

Nanotechnologies — Nano argiles —

*Partie 2: Spécification des caractéristiques et des mesures pour
les argiles en nanofeuillets utilisées dans des applications de films
barrières aux gaz*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 21236 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The barrier property in polymeric materials has become progressively more important in recent years with the widespread use of plastic films and rigid plastics for food packaging, medical packaging, electronic devices, construction, agriculture and so on. All polymeric materials have varying degrees of gas permeability. Therefore, the required level of gas barrier performance varies depending on the application. Barrier films often consist of multilayers or coated films designed to be impervious to gas and moisture migration, as single-layer films are in general quite permeable to most gases. Food packaging films are required to have oxygen gas barrier properties and water vapour barrier properties. A transparent gas barrier film obtained by applying a silica or alumina vapour deposition method on a PET or nylon film is generally used for food packaging, pharmaceutical packaging, industrial product packaging and so on. Recently, a film with a higher level of gas barrier properties has been required for organic light emitting diode displays. These high gas-barrier properties cannot be achieved by simply using conventional barrier film for food packaging.

High gas-barrier films are expected to be used in a wide range of fields, such as electronics, pharmaceutical packaging and hydrogen storage. Various approaches can be taken to improve barrier properties in plastics packaging. There is a method of adding gas-impermeable nano-objects to plastic to make nanocomposites. One of the most common types of polymer nanocomposites contains clay nanoplates. These clay nanomaterials improve barrier properties. Many reports predict the market expansion of nanocomposite materials.

There are many scientific papers and patents on gas barrier composite material using clay nanoplate. Gas barrier properties are improved by mixing clay nanoplates into the polymer. The high gas-barrier phenomenon is described in Nielsen's tortuous model. There are lots of clay products in suspension or powder forms and the effect of loading is different in each. Different production processes bring various characteristics to clay-containing materials. Various clay products are available to buy, including smectite, talc, kaolinite and mica. Some are suitable for gas barrier properties while others are not. Among them, clay products having a high aspect ratio and high affinity with plastic are preferable. Users of clay nanoplate products should check the characteristic data described in the catalogue, as these are important for selecting high-quality clay nanoplates for gas-barrier films.

[ISO/TS 21236-1](#) specifies characteristics of layered clay nanomaterials in powder form, as well as chemically modified ones, and describes their relevant measurement methods.

This document specifies the characteristics to be measured of clay nanoplate and specifies industrially available measurement methods used to determine these characteristics. In addition, measurement protocols are described. It provides a sound basis for the research, development and commercialization of clay nanoplate materials for the application of barrier films for water vapour and dry gases.

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Nanotechnologies — Clay nanomaterials —

Part 2:

Specification of characteristics and measurements for clay nanoplates used for gas-barrier film applications

1 Scope

This document specifies characteristics to be measured and measurement methods for clay nanoplate samples in powder and suspension forms used for gas-barrier films. In addition, measurement protocols for the individual characteristics are described.

This document does not deal with characteristics of post-manufacturing modification of clay nanoplates. This document does not cover considerations specific to health and safety issues either during manufacturing or use.

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.

ISO/TS 80004-6, *Nanotechnologies — Vocabulary — Part 6: Nano-object characterization*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 80004-6 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

gas barrier film

film that reduces gas diffusion

3.2

nanoplate

nano-object with one external dimension in the nanoscale and the other two external dimensions significantly larger

[SOURCE: ISO/TS 80004-2:2015, 4.6, modified]

3.3

clay nanoplate

nanoplate composed of clay