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## **Nanotechnologies — Nanoscale titanium dioxide in powder form — Characteristics and measurement**

*Nanotechnologies — Dioxyde de titane à la nano-échelle sous forme  
de poudre — Caractéristiques et mesurage*



Reference number  
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ISO/TS 11937 was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

## Introduction

Titanium dioxide,  $\text{TiO}_2$ , has been used extensively for circa 90 years as the main white pigment in paints, plastics, printing inks and many other products due to its ability to scatter visible light and provide white opacity to the products in which it is used. More recently, nanoscale titanium dioxide has been developed, here the smaller particle size does not provide pigmentary properties but gives a transparent product which can be used in different applications such as sunscreens or catalysis where the small particle size can enhance the activity. Accordingly, there is a need to better define the characteristics of the nanoscale material providing these alternative properties. This technical specification provides the methods to evaluate mass fraction of the rutile and anatase titanium dioxide as well as to measure four key parameters: crystal structure, average crystallite size, average primary particle size and specific surface area, which are commonly used to indicate characteristics of nanoscale materials.

Most of the manufactured nanoscale titanium dioxides are synthesized by the sulfate process, the chloride process or the sol-gel process, and the crystal structures of the products are almost entirely rutile and anatase. Therefore, brookite and amorphous forms are not specified in this Technical Specification. The X-ray diffraction (XRD) method is used to measure the crystal structure and the ratio of anatase to rutile.

Commonly, some of the nanoscale titanium dioxide products are coated with silica or alumina for specific applications. Alternatively, some of the nanoscale titanium dioxide products may include a dopant of another metal within their crystal lattice for other specific applications. These coatings and dopants are permanent. Buyer, seller and regulator should be aware the presence of any coatings. The XRD method and transmission electron microscopy (TEM) are used to measure crystal size and primary particle size/shape, respectively. The Brunauer, Emmet and Teller (BET) method is widely used for the evaluation of specific surface area. Theoretically, XRD just measures the core size of the coated nanoscale titanium dioxide but not the surface coating. TEM is used to measure the physical primary particle size including surface coatings.

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