



Standard Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption¹

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1. Scope

1.1 This test method covers determination of surface area of advanced ceramic materials. This test method specifies general procedures that are applicable to many commercial physical adsorption instruments. This test method provides specific sample outgassing procedures for listed materials, including silicon carbide, silicon nitride, and zirconium oxide. It includes additional general outgassing instructions for other advanced ceramic materials. The multipoint equation of Brunauer, Emmett and Teller² (BET) along with the single point approximation of the BET equation form the basis for all calculations.

1.2 This test method does not include all existing procedures appropriate for outgassing advanced ceramic materials. The included procedures provided acceptable results for samples analyzed during round robin testing. The investigator must determine the appropriateness of listed procedures.

1.3 This test method uses SI units as standard. State all numerical values in terms of SI units unless specific instrumentation software reports surface area using alternate units. In this case, present both reported and equivalent SI units in the final written report. Many instruments report surface area as m^2/g , instead of using correct SI units (m^2/kg).

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 1993 Test Method for Precipitated Silica—Surface Area by Multipoint BET Nitrogen Adsorption³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

¹ This specification is under the jurisdiction of ASTM Committee C-28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.05 on Characterization.

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² Brunauer, S., Emmett, P. H., and Teller, E., *J. Am. Chem. Soc.* 60, 1938, pp. 309–319.

³ *Annual Book of ASTM Standards*, Vol 09.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

3. Terminology

3.1 Definitions:⁵

3.1.1 *adsorbate*, *n*—material that has been retained by the process of adsorption.

3.1.2 *adsorbent*, *n*—any solid having the ability to concentrate significant quantities of other substances on its surface.

3.1.3 *adsorption*, *n*—a process in which fluid molecules are concentrated on a surface by chemical or physical forces, or both.

3.1.4 *adsorptive*, *n*—any substance available for adsorption.

3.1.5 *aliquant*, *n*—a representative portion of a whole that divides the whole leaving a remainder.

3.1.6 *outgassing*, *n*—the evolution of gas from a material in a vacuum or inert gas flow, at or above ambient temperature.

3.1.7 *physical adsorption (van der Waals adsorption)*, *n*—the binding of an adsorbate to the surface of a solid by forces whose energy levels approximate those of condensation.

3.1.8 *surface area*, *n*—the total area of the surface of a powder or solid including both external and accessible internal surfaces (from voids, cracks, open porosity, and fissures). The area may be calculated by the BET (Brunauer, Emmett, and Teller²) equation from gas adsorption data obtained under specific conditions. It is useful to express this value as the specific surface area, for example, surface area per unit weight of sample (m^2/g).

3.1.9 *surface area (BET)*, *n*—the total surface area of a solid calculated by the BET (Brunauer, Emmett, Teller²) equation, from nitrogen adsorption or desorption data obtained under specific conditions.

3.1.10 *surface area, specific*, *n*—the area, per unit mass of a granular or powdered or formed porous solid, of all external plus internal surfaces that are accessible to a penetrating gas or liquid.

4. Summary of Test Method

4.1 An appropriate sized sample (to provide at least the minimum surface area required for reliable results for the instrument or apparatus used) is outgassed under appropriate conditions prior to analysis.

4.2 (*Multipoint BET Analyses Only*)—Volume of gas adsorbed, or desorbed, is determined for a minimum of four

⁵ *Compilation of ASTM Standard Terminology*, 8th ed, 1994.