

Terminology and Standards for ENP Characterization

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Presentation Outline

- Need for ENP Standardization
- ENP Terminology
- ENP Characterization Techniques
- Characterization Standard Methods
- Standards Development Bodies
- Certified Reference Materials

Need for ENP Standardization

- Why do we need standard terminology?
- Why do we need standard analysis methodology?
- Why do we need standard reports?
- Why do we need certified reference materials?

Need for ENP Standardization

- The use of standard definitions helps to ensure better understanding during discussions between parties, particularly in new, emerging, technologies.
- The use of standard analysis methods, including sample preparation, helps to ensure better reproducibility between laboratories.

Need for ENP Standardization

- The use of standard report specifications helps to ensure better understanding of characterization results between parties.
- The use of certified reference materials helps to ensure that the analysis methods and instrumentation are providing expected results, improving confidence in the results produced for analyzed samples.

ENP Terminology

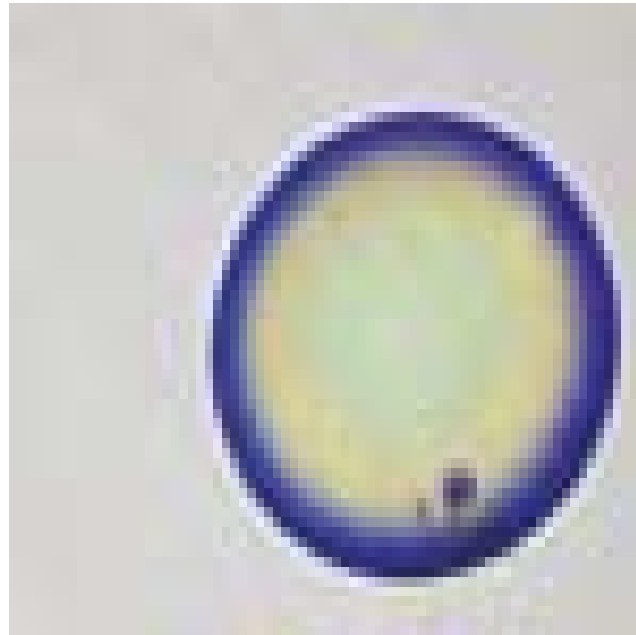
- ISO/TS 27687:2008 from ISO/TC229
- particle – minute piece of matter with defined physical boundaries
- nanoscale – size range from approximately 1 nm to 100 nm
- nano-object – material with one, two or three external dimensions in the nanoscale

ENP Terminology

- aggregate – particle comprising strongly bonded or fused particles where the resulting external surface area may be significantly smaller than the sum of calculated surface areas of the individual components
- agglomerate – collection of weakly bound particles or aggregates or mixtures of the two where the resulting external surface area is similar to the sum of the surface areas of the individual components

ENP Terminology

- nanoparticle – nano-object with all three dimensions in the nanoscale



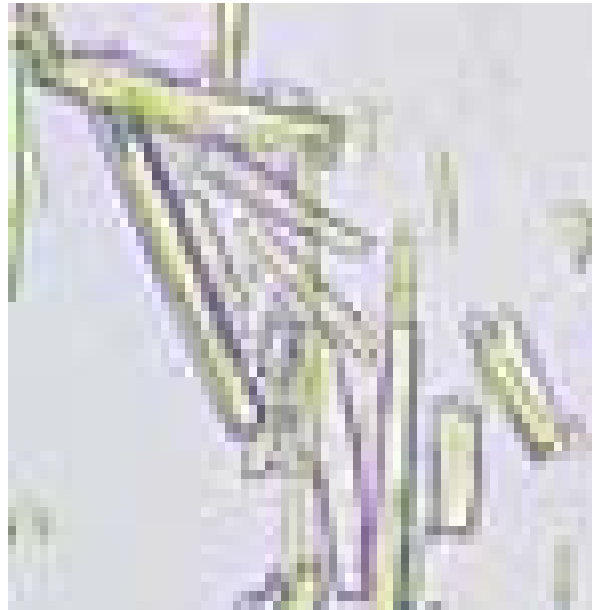
ENP Terminology

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



ENP Terminology

- nanofibre – nano-object with two similar external dimensions in the nanoscale and the third dimension significantly larger



ENP Terminology

- nanotube – hollow nanofibre
- nanorod – solid nanofibre
- nanowire – electrically conducting or semi-conducting nanofibre
- quantum dot – crystalline nanoparticle that exhibits size-dependent properties due to quantum confinement effects on the electronic states

ENP Characterization Methods

- Gas Adsorption for surface area and pore width distribution, particularly with nanotubes – ISO 9277, ISO 15901-2, ISO 15901-3 from ISO/TC24/SC4
- Dynamic Light Scattering (DLS) for particle size determination (PSD) – ISO 13321, ISO 22412 from ISO/TC24/SC4, ASTM E2490 from ASTM Committee E56
- Differential Centrifugal Photosedimentation for PSD – ISO 13318-1, 13318-3, and 13318-4 from ISO/TC24/SC4
- Ultrasonic Attenuation, Electroacoustics, for PSD – ISO 20998-1 from ISO/TC24/SC4

ENP Characterization Methods

- Small Angle X-ray Scattering (SAXS) for PSD – ISO/TS 13762 and new Standard under development by ISO/TC24/SC4/WG10
- Differential Mobility for Aerosol PSD – ISO 15900 from ISO/TC24/SC4
- Zeta-potential analysis for suspension stability – ISO 13099 – 1, ISO 13099-2 from ISO/TC24/SC4
- Electron Microscopy (SEM and TEM) for PSD and shape analysis – Standards under development by ISO/TC229; Image Analysis – ISO 13322-1 from ISO/TC24/SC4

Characterization Reports

- Using standard report definitions and practices is critical to understanding particle characterization results.
- Representation of particle size analysis, ISO 9276, currently in 5 parts, from ISO/TC24/SC4.
- Includes standard definitions of distribution moments and averages, as well as advice on use of standard distributions, and particle shape.

Standards Develop Organizations

- ISO and Member Bodies – ANSI, BSI, DIN, JISC, AFNOR, CEN, and many others
 - ISO/TC24 on Particle Characterization including Sieving
 - ISO/TC24/SC4 on Particle Characterization – 15 Working Groups
 - ISO/TC229 on Nanotechnologies – 4 Working Groups
- ASTM International Committees
 - ASTM Committee E56 on Nanotechnology – 3 Subcommittees
 - ASTM Committee E29 on Particle Characterization – 3 Subcommittees

Certified Reference Materials

- National and International Certifying Bodies including
 - BAM
 - NIST
 - JRC-IRMM/
 - APPIE/JIS
- Secondary Traceable Materials including
 - ThermoFisher
 - Polysciences
 - Whitehouse Scientific

Summary

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Terminology and Standards for ENP Characterization

- Thank you to the Organizers and to the Participants of the Workshop
- Any Questions?