TECHNISCHE UNIVERSITÄT DRESDEN

Co-Nanomet
Co-ordination of Nanometrology in Europe

Faculty of Mechanical Engineering Institute of Process Engineering and Environmental Technology Research Group Mechanical Process Engineering

General aspects of particle sizing

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EU Co-Nanomet Workshop

Instruments, standard methods and reference materials for traceable nanoparticle characterisation

Nuremberg, Germany, 28/29 April 2010

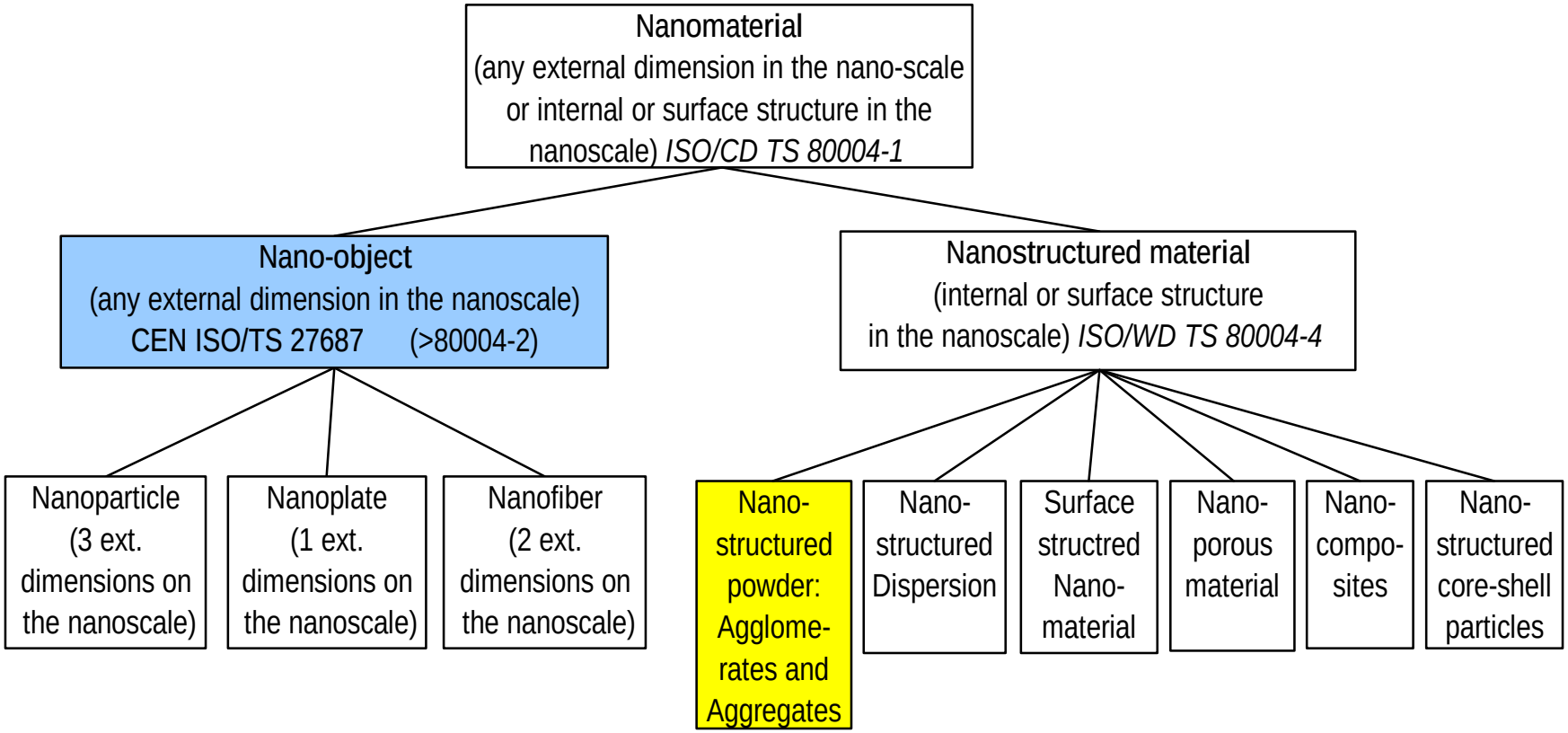
"Instruments, standard methods and reference materials for traceable nanoparticle characterisation"

www.nanoparticle-metrology.de

Topics of engineered nanoparticles action group:

- assess the current metrology status with regard to:
  - relevant measurands (depending on the context of the measurement)
  - available measurement techniques, their limits and fields of application
  - the dissemination of such techniques to science, industry and public authorities
  - traceability and measurement uncertainty
  - standardisation
  - reference materials
- reveal current and future needs for engineered nanoparticles metrology

ISO/TC 229 „Nanotechnologies“, JWG 1 „Definitions“, current state:



Challenges from nanotechnology

e.g. for chemical engineers in particle technology

Communication with National Metrology Institutes, material scientists, colloidal chemists, medical and environmental toxicologists, exposure experts, regulatory institutes

- Definitions: e.g. nanomaterial, categories for risk assessment?
- Scenarios: static properties – dynamic processes (e.g.particle release)
- SOPs: learn from industry with controlled conditions
- Standardized measurement methods: selection, traceability, errors
- Reference materials for what purpose?
- Guidance from whom?

Why different methods?

- microscopy: spatially resolved interaction of sample with electrons, light, particles/molecules; static & dynamic)
- fractionating methods: fractionation (acc. to mobility) + detection
- static scattering techniques (SLS, SAXS, SANS)
- dynamic scattering techniques (DLS, DXS)
- other spectroscopic methods (light, acoustic, electric fields)
- integral/concentration measurement (BET, turbidity, CPC, …)
- techniques for characterising the interfacial properties (e-kinetic, e-acoustic, non-linear optic)

General (complete) phys. chem. characterization for all purposes?

Pietfalls in particle characterization

Sampling and sample splitting errors (size dependent losses, e.g. diffusion)

Preparation errors (agglomerate dispersing, drying agglomerates)

Particle concentration effects:

1. Coincidence errors of counting methods
2. Hydrodynamic interaction of assumed isolated single particles (movement hindering or acceleration)
3. Multiple scattering in optics (or acoustics)

Convective flow of surrounding liquid or gas, (thermal, backflow, electro-osmosis)

(electro-, thermo-) phoretic movement of particles

Instability of the sample: Demixing (time),

Agglomeration (time, concentration) / Dispersing of agglomerates (shear)

Particle structure (and shape) - influence on measurand and type of quantity

Tracing – relating to a reference

Sensor Signals

Product Property
for applications (Bio-availability, colour, taste, abrasion...)
for production (filtratability, flowability, stability,...)

Sensor Model

Property Function

Particle Characteristics (Particle size, - shape, - porosity , – morphology)

Stability Model

Process Function

Physical, chemical interface properties

thermodynam. state

mechan. treatment

Process Parameters
(rotation speed, residence time, milling ball size, temperature)

Tracing – relating to a reference

Sensor Signals

Product Property
for applications (Bio-availability, colour, taste, abrasion...)
for production (filtratability, flowability, stability,...)

Sensor Model

Property Function = Dose-Response Relation ?

Particle Characteristics (Particle size, - shape, - porosity , – morphology)

Stability Model

Process Function

Physical, chemical interface properties

thermodynam. state

mechan. treatment

Process Parameters
(rotation speed, residence time, milling ball size, temperature)

Fathers list

of particle characterization in powder technology or mechanical process technology

Hans Rumpf

Kurt Leschonski

Brian Kaye

Terry Allen

G. Jimbo

Brian Scarlett

H. Masuda

Reg Davies

Speakers list 28 April

ISO/TC24/SC4 Particle Characterization ("other than sieving", F. Haver, K.Leschonski)

T. Thornton (Micromeritics, USA): Terminology and standards for ENP characterisation

G. Roebben (JRC-IRMM, EU): Metrology for particle sizing

B. Sachweh (BASF, DE): Quality assurance and process control

T. Kuhlbusch (IUTA, DE): ENP characterization in view of health studies – NANO-CARE

M. Hassellöv (University Gothenburg, SE): ENP sizing …for environmental risk assessment

P. Bowen (EPFL, CH): Comparing methods for measurements in liquid

A. Rawle (Malvern, USA): Characterisation of NPs with DLS

W. Witt (Sympatec, DE): Sizing with on-line methods

A. Dukhin (Dispersion Technology, USA): Measuring interfacial prop. using electroacoustics

R. Xu (Beckman Coulter, USA): Zeta-potential measurement

D. Lerche (L.U.M., DE): Suspension stability

Speakers list 29 April

ISO/TC24/SC4 Particle Characterization

G. Sem (TSI, USA): Survey on aerosol measurement techniques

R. Aitken (IOM, UK): Exposure assessment in settings relevant to nanotechnologies

A. Lamberty (JRC-IRMM, EU): Reference materials: concepts, applications and ex-amples

V. Hackley (NIST, USA): Experiences with ENP reference materials

Y. Mori (Doshisha Uni, JP): Preparation of sub-micrometer particles for reference materials

M. Krumrey (PTB, DE): Size determination of NPs with SAXS

H. Sakurai (AIST, Japan): Chairman aerosols

F. Babick (TUD, DE): Chairman liquid media

A. Jamting (NMI Sydney, Australia): Poster Interlab. Comparison