CHARACTERIZATION, TESTING AND STANDARDIZATION OF NANOMATERIALS IN MALAYSIA

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Nanomaterials & Nanotechnology

- large diversity of engineered nanomaterials: vary in chemical makeup, size, shape, and coating

- Emerging technology

- Known to impact many benefits

- There are products on market that claim to incorporate these technologies.
What is Nano?

- Nanoscale: size at least 1D (1-100nm)

Diagram:
- Nanomaterial: (one or more external dimensions or an internal or surface structure on the nanoscale)
  - Nano-object: (one or more external dimensions on the nanoscale)
    - Nanorod: 2D <100nm
    - Nanoplate: 1D <100nm
    - Nanoparticle: 3D <100nm
  - Nano-structured material: (internal or surface structure on the nanoscale)
    - Nanocomposite?
    - Nanocrystalline material?
    - Agglomerate /aggregate?
    - Others?

CD TS 27687
Measurement of nanoparticle in air?
Example: Measurement of nanoparticle in air

STANDARDIZATION IS IMPORTANT!
How to measure?

- Size? Diameter? Specific surface area?
- Volume? Homogeneity? Dispersity?

Example of tools:
- Size (nm): Transmission electron microscopy (TEM)
- Specific surface area (m²/kg): Gas adsorption (BET)
- Homogeneity: PDI by nanosizer
- Stability in suspension: zeta sizer

size of objects is a critical parameter for labeling and regulation of nanomaterials to determine whether it is nano or not
Why need standardization?

Strategic tools & guideline to help company to tackle business challenge, ensue operation as efficient as possible, increase productivity and help companies access new markets-
Written Standards

Describe ‘the way of doing thing’

Formal standard:
• developed by independent expert work under National, regional or International Standard body. Eg: ISO, IEC…
• Proposed, developed and approved by the members of standard body, based on consensus.
Goal of Standards

For promotion of nanotechnologies

1) commercialization and global trade

2) Acceptance to society
ISO TC 229 “Nanotechnologies”

- Created in 2005
- 34 ‘P’ member, 13 ‘O’ member
- **Scope:**
  1) Understand & control material and processes at nanoscale
  2) Exploit properties of nanomaterial to create better product/system.
## Subcommittee for TC229 & specific tasks

<table>
<thead>
<tr>
<th>ISO/TC 229 Task Force</th>
<th>Specific tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO/TC 229/CAG</td>
<td>Chairman Advisory Group</td>
</tr>
<tr>
<td>ISO/TC 229/JWG 1</td>
<td>Terminology and nomenclature</td>
</tr>
<tr>
<td>ISO/TC 229/JWG 2</td>
<td>Measurement and characterization</td>
</tr>
<tr>
<td>ISO/TC 229/TG 2</td>
<td>Consumer and societal dimensions of nanotechnologies</td>
</tr>
<tr>
<td>ISO/TC 229/TG 3</td>
<td>Nanotechnologies and sustainability</td>
</tr>
<tr>
<td>ISO/TC 229/WG 3</td>
<td>Health, Safety and Environmental Aspects of Nanotechnologies</td>
</tr>
<tr>
<td>ISO/TC 229/WG 4</td>
<td>Material specifications</td>
</tr>
</tbody>
</table>
Major Standardization issue for nanomaterials

Five critical areas:

1) Coordination and harmonization across standards developers and stakeholder
2) Terminology (JWG 1)
3) Measurement and characterization (JWG 2)
4) Health, safety and environment (WG 3)
5) Material specification. (WG 4)
IEC TC 113

“Nanotechnologies standardization on electrical and electronic products and systems”.

- **Scope**: Standardization of the technologies relevant to electrical and electronic products and systems in the field of nanotechnology in close cooperation with other committees of IEC and ISO TC 229

- Total 8 items published.
- Malaysia as ‘P’ member
Malaysia as participating “P” Member

- 143 ‘P’ member and 26 ‘O’ member in ISO and IEC
- Among them: ISO TC 229 “Nanotechnologies” & IEC TC113 “Nanotechnologies standardization on electrical and electronic products and systems”.
- DSM – National standard & accreditation body, is the official representative of Malaysia to the ISO TC 229 and IEC TC113
- SIRIM Bhd.- mandated as the sole Standard development agency
TC 229/ WG 2 National committee:
1) Comment on all the ISO and IEC document
2) Develop standard
3) Attend meeting for committee
ISO/TC 229/JWG 2
Measurement and characterization

• How you measure or test it?
• Strategic objectives:

1) To develop measurement and characterisation standards for use by industry in nanotechnology-based products.

2) To work closely with all the ISO/TC229 working groups in producing standards of common interest by developing the necessary characterisation, measurement and test standards.

3) To ensure co-ordination with relevant work in other ISO TCs, developing measurement and characterization standards, and with OECD Committees, as appropriate.
Priority Area in JWG2

• A – Standard for measurement and characterization of CNT and related structure (Nanocarbons)
• B – Standard for measurement and characterization of engineered nanoparticles
• C – Standards for measurement and characterisation of coatings
• D – Standards for measurement and characterisation of nanostructured materials (Composites and Porous structures)
• E – Standards for basic metrology at the nanoscale
• F – Guidance for characterization, specification and production of reference materials
Nanomaterials are really complex, and if you just carry out one or two tests, you’re going to miss something.”
JWG 2 Work programme on MWCNT

Electrical characterization of Carbon Nanotubes Using 4-Probe Measurement (TS)

Measurement Methods for Characterizing Multi-Walled Carbon Nanotubes (TR)

Determination of shape factors of multiwalled carbon nanotubes (TS)

Determination of Metal Impurities in Carbon Nanotubes Using Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) - TS
Achievement by JWG 2

• 8 TS published
TS 10798: SWCNT- SEM/EDXA
TS 10868: SWCNT- Uv-Vis-NIR
TS 10867: SWCNT- NIR-PL
TS 11251: SWCNT- EGA-GCMS
TS 11308: SWCNT- TGA
TS 11888: Shape factor of SWCNT
TS 13278: Metal impurities in CNTs – ICP-MS
TR 10929: MWCNT- characterization

• 1 in printing
TS 10797: SWCNT-TEM
**TS under development JWG2**

- *(TS 12025): DIN Lead*
  Nanomaterials — Quantification of nano-object release from powders by generation of aerosols

- *(IEC 62622): DIN Lead*
  Nanotechnologies – Description, measurement and dimensional quality parameters of artificial gratings

- *(TS 16195): JISC Lead*
  Nanotechnologies -- Guidance for developing test materials consisting of nano-objects in dry powder form

- *(TS 17466): SAC Lead*
  Use of UV-Vis absorption spectroscopy in the characterization of cadmium chalcogenide semiconductor nanoparticles (quantum dots)
Standard Developed in Malaysia


ISO/TC 229/ TG 2
Consumer and societal dimension (CASD) of nanotechnologies

• Study and report developed by Dr. Aini Mat Said (UPM), Dr. Elistina Abu Bakar, Dr. Hasmah Sulaiman and Prof. Fakhrul Razi Ahmadun.
• Respondent from 14 ‘P’ members countries
• useful references that can be adopted and adapted by NMB of ISOTC 229 to improve their engagement with society at large and with organizations representing the interest of consumers and civil society
Conclusion

• Standard for nanomaterial is important
• to ensure that nanomaterials is developed and commercialised in an open, safe and responsible manner by supporting:
  • worker, consumers and environmental safety
  • commercialisation and procurement
  • patenting and IPR
• communication about the benefits, opportunities and potential problems associated with nanomaterials. This will be achieved by providing agreed ways of:
  • Naming, describing and specifying things
  • Detecting, characterizing, Measuring and testing things
  • Safety testing, legislation and regulation
  • Health and environmental testing, risk assessment and risk management
Thank you!