Group 3: Carbon Nanostructures

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Most Critical Terminology Issues for Discussion and Resolution

- Descriptions of physical dimension(s), including polydispersity **(10)**
- Descriptions of structures at multiple hierarchies (e.g., primary = molecular, secondary = local aggregation, etc.) **(9)**
- Descriptions of surface features (e.g., reactivity, functionalization, surface area, porosity) **(8)**
- Incorporation/consideration of existing nanomaterial terminologies, including legacy materials (e.g., carbon black, diesel exhaust) **(7)**
- Universality of terminology systems beyond carbon **(7)**

Other issues raised

- What's in the sample besides carbon (both separate particles and defects)? (6 votes)
- What should be considered to be a nanoparticle/nanomaterial (e.g., is one nanoscale dimension enough)? (5 votes)
- What measurement technique was used and what influence does that have on the observed parameters? (3 votes)
- How different must a property be in order for it to be considered "different" in defining nanomaterials? (1 vote)
- Should covalent and noncovalent nanomaterials be subject to the same terminology rules? (0 votes)
- Terminology for mixtures/composites. (0 votes)
- Should we ditch the term "nano"? (0 votes)

What standards work is currently underway?

- IEEE
  - Standard under development for nanotube electrical characterization
- IUPAC and CAS
  - Well-established nomenclature systems for fullerenes; should work to incorporate rather than replace those systems
- European Nanobusiness Association
  - A recent initiative that includes both metrology and terminology
- SEMI
  - CMP Slurry standards
- ASTM
  - Carbon black terminology and standards well established
  - Meeting on Friday
- ASME
  - Metrology efforts underway

Missing Stakeholders

- OSHA/NIOSH (needed in carbon group)
- Current producers and users of carbon nanomaterials (e.g., cosmetics, carbon black)
- International interests (IUPAC, IUPAP, ISO, Japan, Royal Academy of Sciences, producers of German study, etc.)
- Public interest groups
- Health care community
- Clean-room industry

Cross-cutting issues with other break-out groups

- Two levels need to be distinguished
  - Above the single particle level, nearly all terminology issues are common to all types of particle (e.g., hierarchical structure descriptions, impurities, etc.), and coordination should be encouraged.
  - At the single particle level, commonality should be encouraged where appropriate (chirality, etc.), but not forced where inappropriate.

Cross-cutting issues with other break-out groups

- Specific areas of overlap:
  - Everything with group 1
  - Composites and hybrids with hybrids group
  - Possibility for description of impurity inorganic materials (not a high priority)

Generation / acceptance of universal terminology impediments

- General Impediments
  - Communication problems among differing scientific/engineering disciplines
  - International and geopolitical climate
  - Costs
  - Stakeholders may have higher priorities
  - Protection of confidential business information (e.g. – polymer industry protection of production information in commodity market)
  - Acceptance by academics
- Issues that cut both ways
  - Strong commercial reasons
  - Patents and IP protection
  - Concerns about regulatory impacts (or the absence of regulatory standard)
  - Labeling concerns

Venues to address needs/potential project leaders

- ASTM
- IEEE
- AIHA

- Important issues to consider
  - Need volunteer expert leaders in field, and critical mass of participants to support effort.
  - Also need some working documents to start with.
  - Factors to consider in choosing SDOs:
    - Expertise
    - Credibility
    - specific subject matter expertise (no nano-SDOs now).
  - Working group can be small, given limited size of production community.

Broader issues of nanotechnology standards

- QA/QC of manufacturing processes
- Metrology
- EH&S
  - Standardized toxicity testing
  - Workplace safety standards
  - Environmental dispersion
  - Environmental and ecological risk assessment

Rover involvement: Terminology strawman

- Sample breakdown of issues brought to us from inorganic group
- General agreement that issues were on-target for carbon systems as well, and would only need tweaking

Future standards work

- General question was whether the development of standards should happen by
  1. Large group covering all nanomaterials
  2. Separate groups for each class of nanomaterial
  3. Hybrid with large group for coordination, but smaller working groups for individual classes
- Divided response
  - Nanomaterials producers wanted #2
    - A major issue was time/efficiency of effort
  - Academics, SDOs, etc. wanted #3
- Points to consider
  - The closer you are to the people who will implement the standards, the more efficient the process
  - Flexible structure needed to accommodate rapidly developing field
  - Nanotechnology is not an industry; its users are in many different industries. This may lead to unusual problems in standardization.
- Straw poll
  - Majority of members would be willing to contribute to development efforts

Specific Recommendations

- Carbon nanostructures would benefit from a standardized nomenclature. The urgency of this need was open to dispute among the stakeholders.
- When working with the inorganic nanostructures group, consensus that hybrid umbrella group approach offers best approach if risks of delay can be minimized (subject to concerns raised by producers).
- Canvas all potential organization sources for existing terminology or nomenclature.