EMRP RESEARCH PROJECT: TRACEABLE CHARACTERIZATION OF NANOPARTICLES

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Nanoparticles are already in use today in different products (e.g. paints, lotions, protective clothes, etc) and there is public discussion on possible hazardous effects of nanoparticles which has to be addressed by standardisation, control, legislation and, therefore, metrology. Effective control of nanoparticles requires measurement, classification and secure handling/manufacturing. High-resolution microscopy techniques for individual nanoparticle characterization exist (SEM, AFM UV optical), but they require standardisation and the resolution needs to be further developed (e.g. smaller wavelength, fs microscopy) and face serious sampling issues to ensure correct analysis. Other, integral metrology techniques also exist: PCS, scattering methods, etc. However, high quality, well defined nanoparticle standards from different materials are lacking. If available, these would help to better cross-correlate the results of local and integral methods and this would allow to achieve the 1 nm accuracy target.

Manufacturing of nano-materials with novel functionalities such as nanotubes and fullerenes requires metrological support through traceable characterisation. In addition well documented concerns about the health risks of nanoparticles, such as combustion, exist. Thus metrological research towards traceable measurements of toxicity, shape, size, size distribution, chemical identity of nanoparticles, etc., will play a key role in the near future.

A fundamental issue for nanoparticles compared to micron size powder is sampling and preparation methods. The consortium previous experience in the field will help to identify high quality particle size standards, suitable for traceable calibration. An important aspect of this project is to determine long-term stability and humidity dependence of the measurements. The partners will develop validated methods for sampling and agree international methods for the characterisation of the nanoparticles measuring instruments.

The analysis of the light scattered by a particle is a powerful method for detecting its shape and size. New optical methods will be investigated and developed to measure complex-shaped particles, highly concentrated dispersions, and push the resolution limit of existing instruments.

The consortium will investigate the use of different materials (metallic, ceramic, polymer) as possible new reference materials to complement the existing types (spherical polystyrol spheres). An important improvement on the state of the art is focused on the comparison between high resolution (SFM, STEM, etc.) and integral (SAXS, optical scatterometry) techniques on different types of nanoparticles. The methods used will range from synchrotron based SAXS for size and size distribution of nanoparticles to dynamic light scattering or AFM measurement.

Shape measurements for sub 100 nm nanoparticles are a real issue for nanoparticle characterization and their applications. An entire work package is dedicated to this important issue. At the end of the project, partners will have introduced a new set of parameters describing non-spherical particles for standard measurements and internationally agreed definitions for characterisation of shape and surface of nanoparticles.

Besides management (WP1) and dissemination (WP6), the project is divided into the following WPs:

WP2: Sample preparation. This is the first important step for comparable results. The sample preparation has to maintain the original size and distribution, together with sufficient stability over time.

WP3: Aerosol measurement. Development of nanoparticle (NP) generation and measurement methods for number concentration, size and shape. A Single Charge Aerosol Reference Instrument (SCAR) will be constructed to realize a validated traceable measurement standard for the number concentration of nanoparticles (NP) for characterisation of commercial NP measuring instruments. An analysis method based on light scattered by a NP will be developed and compared against SCAR.

WP4: Size distribution measurement on spherical nanoparticles. Focused on the comparative measurement of nearly spherical nanoparticles with ensemble (SAXS, DLS, etc.) and single particle orientated methods (SFM, SEM/STEM, etc.) and the cross-check of the obtained results.

WP5: Size and shape measurement on high aspect ratio nanoparticles. Standardized definition for high aspect ratio (1:3) nanoparticles and nanotubes and issues related to shape measurement for nanoparticles.

Participants:

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