First lessons from the **inter-laboratory comparison on SEM images analysis** carried out by **NanoMesureFrance**

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TOPIC / ABSTRACT

NanoMesureFrance organized an **interlaboratory comparison to evaluate the performance of electron microscopy (EM) image analysis software for the characterization of nanomaterials**. The initiative addresses the growing need for reliable and harmonized tools capable of determining number-based particle size distributions from **SEM images** in a regulatory context, particularly for nanomaterial identification.

The benchmark focuses on the extraction of statistical particle size descriptors, including D10, D50, D90, standard deviation, and the proportion of particles below 100 nm. **Participants analyze identical SEM image datasets provided by the Laboratoire national de métrologie et d'essais (LNE)**, thereby eliminating variability related to sample preparation and image acquisition.

Five samples of increasing complexity were selected to assess software robustness under realistic analytical conditions: (1) **monodisperse spherical SiO2 particles**, (2) **well-dispersed TiO2 particles with a median size close to 100 nm**, (3) **poorly dispersed TiO2 aggregates/agglomerates**, (4) **highly polydisperse SiO2 particles**, and (5) **complex bauxite particles** exhibiting strong size polydispersity.

A total of **17 participants contributed to the comparison**. The study highlighted generally good agreement for simple samples, while significant inter-participant variability emerged for complex and highly polydisperse materials, especially for the bauxite sample. In several cases, the determination of whether the median particle size was above or below the 100 nm regulatory threshold depended strongly on the analysis approach used.

The results underline the **importance of harmonized counting rules, validated image analysis procedures**, and **reference datasets** for qualifying automated or AI-assisted EM analysis tools. This intercomparison also e**stablishes a methodological framework for future benchmarking exercises** and contributes to the development of best practices for nanomaterial characterization.

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