"The Field of Particle Analysis is Approached from Two Sides"

Developments in particle analysis

Dr. Jörg Wieder, one of the founders of femtoG, shares his insight on particle analysis and the role of digitalization in the field.

What are the latest developments in particle analysis? *We have an interesting situation where the field of particle analysis is approached from two sides. First, there are new technical solutions that allow the measurement of multiple parameters at once, at high throughput, and possibly online. Second, there is pressure from legislators in the European Union, to characterize particle size, with a particular focus on nanoparticles (particles smaller than 100 nm).*

Both points aren't aligned yet. Many standard sizing methods (e.g., laser diffraction, or ultracentrifugation) give equivalent diameters which are not fully suitable to identify nanoparticle content according to the guidelines of the European Commission. This is where we enter the stage of bridging this gap. We directly measure the mass of single particles – a fundamental property – parallel to a particle diameter. Our novel method is fast, can be automated, and provides information on the particle structure. Beyond that, our analysis allows to crosslink particle properties to many relevant units that are already mass-based, like price ($/kg), toxicity (mg/kg body weight), or surface area (m²/g).

What are the challenges for measuring nanoparticles? *Defining what counts as a nanoparticle may in itself already be the greatest challenge. Very few particles are well-defined geometric objects like spheres or cylinders and thus easily characterized by a one-dimensional length scale. Therefore, all sizing methods measure equivalent diameters (more than 10 definitions exist) – none of which have been proven reliable at identifying nanoparticles.*

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Consequently, only electron microscopy imaging techniques are accepted for identifying nanoparticles, which are slow and costly. Despite being powerful, electron microscopy can only deliver a relative nanoparticle content, yet it is the absolute number of nanoparticles per gram of product that matters – especially for a health and safety assessment. Moreover, a mass measurement is independent of optical properties (such as refractive indices). This is especially helpful for the characterization of multicomponent systems, e.g., when quantifying coating material break off from core particles).

How much can automation and digitization play a part? *Automation and digitization as a concept can surely boost the efficiency of existing processes in the way of making them faster and cheaper. However, they are much less useful when we don't fully understand certain properties and parameters. In my opinion, we must ask ourselves whether we measure the right properties before analytical capacities are scaled up. New measurement concepts relying on aerosolized particles, like ours, could have a stronger leverage towards efficiency; as they have a continuous sample flow by default, they can be employed online to shorten feedback loops significantly.*

From a traditional perspective, electron microscopy seems an obvious candidate for automation – add automatic sampling and use advanced AI image analysis algorithms. Yet, at its roots, you apply a 2D solution to a 3D problem to obtain a 1D number, e.g., Feret diameters. If you just want to count the particles of different sizes, it is debatable whether this automation strongly increases efficiency – in my opinion, it doesn't.

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