Nanoparticle Characterization: Challenges & Approaches

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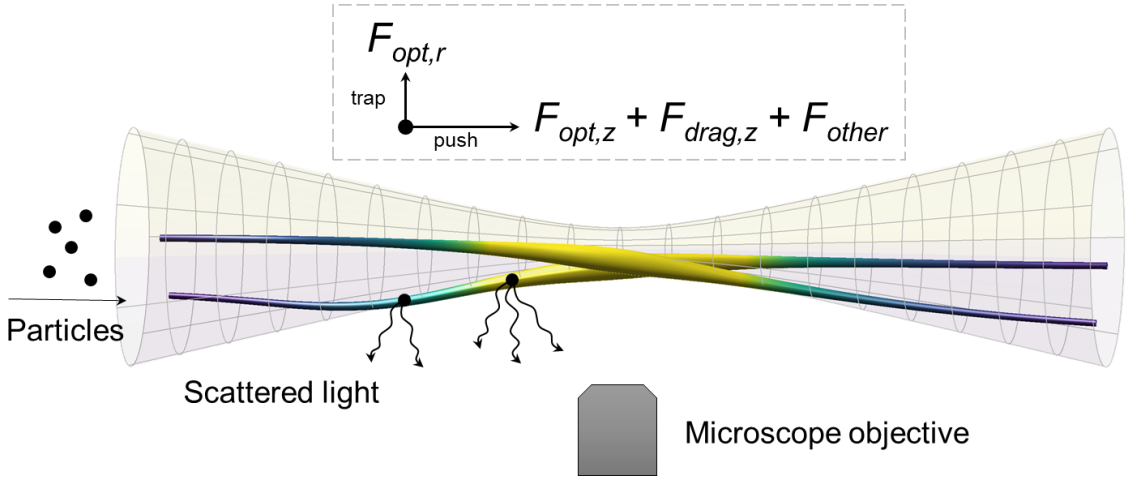

Modern nanoparticle research and production relies on reliable and precise methods for characterizing nanomaterials. Many parameters such as size and size distribution, concentration and shape of nano-objects play an important role when it comes to functionalization of these particles. Due to the nature of nano- and micro-scale objects, several challenges arise for characterization technologies, especially within dynamic processes.

In this paper we present the most common parameters of interest and state of the art technologies such as Dynamic Light Scattering and Nano Particle Tracking Analysis together with their underlying physical principles. To gain dynamic insights of various processes, a novel characterization scheme, OF2i is introduced.[1] Our experimental setup builds on precisely controlled fluidics together with a focused laser beam with orbital angular momentum. By monitoring single-particle light scattering and nanoparticle trajectories, we obtain detailed number-based information of individually tracked particles.

We discuss the basic physical principles underlying the OF2i scheme and demonstrate its applicability through standardized particles as a reference. Our simulation approach is based on Maxwell's equations and Mie's theory, in combination with realistic laser fields and fluidic forces.[2,3] This measurement scheme is applied to different particle systems and evaluated within our theoretical framework, where we also monitor evolutionary processes over large time scales. Our results prove that OF2i can provide a flexible work bench for numerous pharmaceutical and technological applications.

[1] C. Hill. (2020). EU Patent No. 3422364B1. European Patent Office.
[2] Ashkin A., *PNAS* **1997**, *94*, 4853–4860.
[3] A. D. Kiselev and D. O. Plutenko, *Phys. Rev. A* **2014**, *89*, 043803.