

Miniaturized Asymmetrical Flow Field-Flow Fractionation for the fast and reliable characterization of nanoparticles

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Asymmetrical Flow Field-Flow Fractionation (AF4) is a reliable analytical tool for the fractionation and comprehensive characterization of nanoparticles and the most common sub-technique of Field-Flow Fractionation (FFF). In FFF, separation is generally based on a separation field that is perpendicular to the laminar eluent flow in an open separation channel (Fig. 1). In AF4, this separation field is induced by a cross flow, which forces the nanoparticles towards the porous channel bottom covered by a semipermeable membrane. Separation then takes place according to the different sizes/diffusivities of the nanoparticles with smaller nanoparticles elute before larger ones.

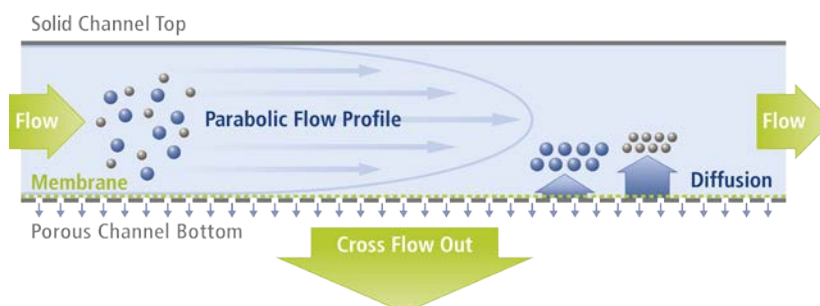


Fig. 1: Principle of the AF4 separation technique.

We herein present the application of a miniaturized AF4 channel (Fig. 2) for the separation and characterization of nanoparticles.

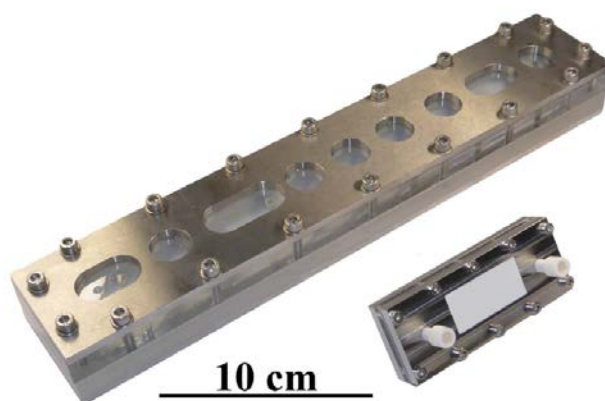


Fig. 2: Size comparison of the conventional and the miniaturized AF4 channel.

The performance of the miniaturized channel was tested against mixtures of polystyrene and gold nanoparticles. Comparison with a conventional AF4 channel revealed significantly reduced analysis times (Fig. 3) as well as solvent and sample consumption [1].

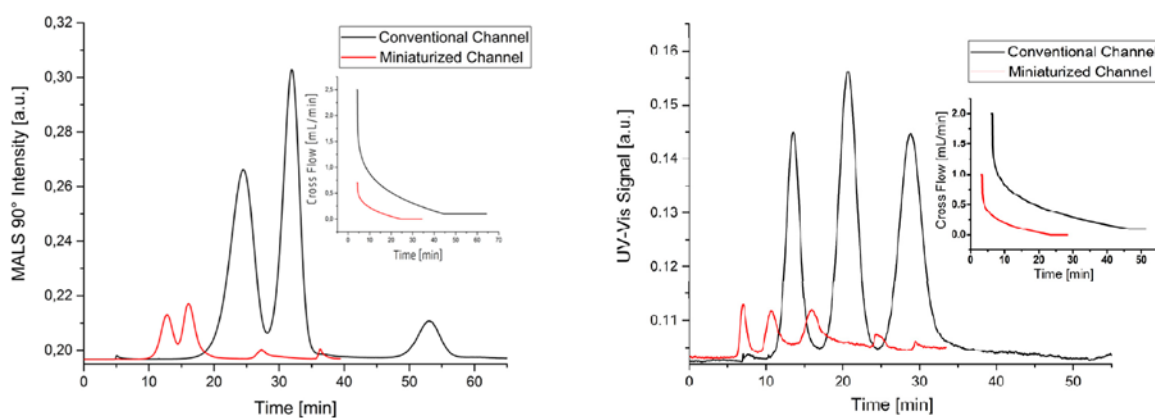


Fig. 3: Fractionation of mixtures of polystyrene (50, 100, 400 nm, left) and gold nanoparticles (10, 30, 60 nm, right).

The miniaturized AF4 channel can be also hyphenated with advanced detection systems such as e.g., multi-angle light scattering (MALS). This setup enables the fractionation and sizing of nanoparticle samples with a broad particle size distribution in less than 20 minutes (Fig. 4) [2] rendering it the ideal tool for high-throughput screening.

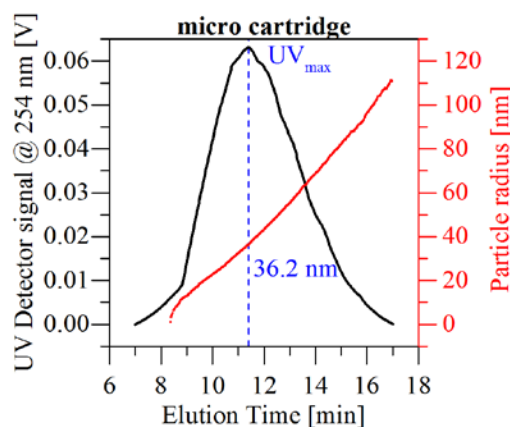


Fig. 4: Fractionation and sizing of TiO_2 -nanoparticles (Evonik AeroDisp® W740X).

References

- [1] Z. You, F. Meier, S. Weidner, "Comparison of Miniaturized and Conventional Asymmetrical Flow Field-Flow Fractionation (AF4) Channels for Nanoparticle Separations." *Separations*, 2017, 4(1): 8-19.
- [2] D. Müller, S. Cattaneo, F. Meier, R. Welz, A.J. deMello, "Nanoparticle separation with a miniaturized asymmetrical flow field-flow fractionation cartridge", 2015, *Frontiers in Chemistry* 3.