# Physicochemical characterization of nanometric materials by A4F-MALLS-ICPMS and DLS: industrial and environnemental applications.

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## Abstract

Nanomaterials (NM) open huge prospects for innovation in different fields such as medicine, electronics, cosmetics and materials [1]. However, their uses raise questions about possible risks to the environment and humans [2]. The development of suitable protocols for the physicochemical characterization (size distribution, shape and chemical composition) of such materials is a fundamental issue for coming years [3]. To meet the needs of various industrial producing or using NM, UT2A has developed new analytical approaches dedicated to nanometrology.

According to the needs expressed by industry, two approaches were considered. The first one is focused on the determination of the size distribution of nano-scale particles using Dynamic Light Scattering detector (DLS) and a splitting system (by size and weight) such as Asymmetric Flow Field Flow Fractionation hyphenated with a Multi Angle Laser Light Scattering detector (A4F-MALLS). The second approach is based on a comprehensive physicochemical characterization made by the combination of A4F-MALLS with an Inductively Coupled Plasma Mass Spectrometer (ICP-MS).

The first part of the work has consisted in the size control of Metallic NanoParticles (MNP) and Carbon NanoTubes (NTC) respectively used in cosmetics and computer science (Figure 1). The main difficulty resided in the sample preparation protocol. To do so, the nature and concentration of the surfactant and the mechanical means were considered. Subsequently, the work was focused on the optimization of industrial processes. The development of a new method for monitoring aeronautical degreasing baths containing surfactant micelles (nano-scale entities) by DLS improved their managements and significantly reduced costs and the volume of effluents. An industrial process of cheese manufacturing has also been optimized by evaluating the influences of the temperature and the homogenization step on the final cheese texture by analyzing the size distribution of milk creams.

The second part of the work was focused on the development of A4F-MALLS-ICP/MS for the physicochemical characterization of NM in sunscreens (Figure 2). The protocol of extraction of NM (solvent, centrifugation, dispersion, etc.) and the optimization of the separation step were implemented (mobile phase composition, fractionation step, etc.). The same hyphenated system was also used to evaluate the physicochemical characteristics of environmental colloids and their interactions with various metallic pollutants (Figure 3). The analysis of leachates have demonstrated that most of metals (Cu, Zn, Ni, As, Cd) investigated were dissolved instead between 20 and 90% of Al, Fe and Pb were associated with particles from 50 to 350 nm.

## References

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[2] V.L. Colvin, Nature Biotechnology **21** (2003) pages 1166-1170.
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**Figures**

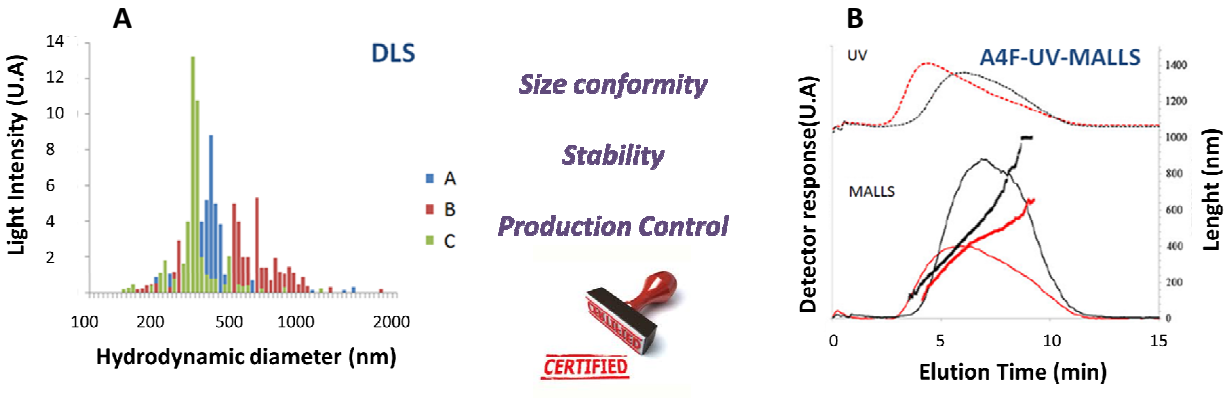


**Figure 1. Characterization of the size distribution of sunscreens by DLS (A) and carbon nanotubes by A4F-MALLS (B).**

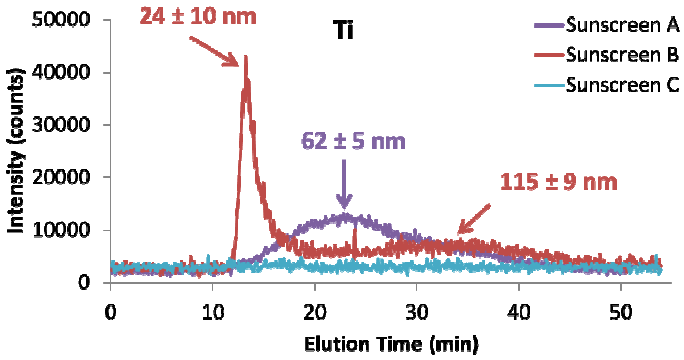


**Figure 2. Characterization of titanium nanoparticules in sunscreens by A4F-MALLS-ICPMS.**

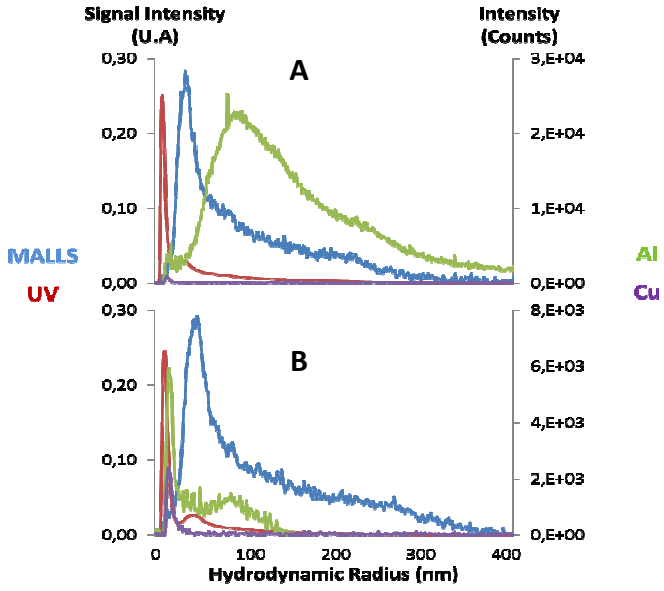


**Figure 3. Characterization of environmental colloids in leachates (A, B) by A4F-UV-MALLS-ICPMS.**