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Coupling Digital Microfluidics with ICPMS for single nanoparticle or cell analysis

Valérie Geertsen*[1], Théo Jourdain , and Florent Malloggi

[1]Nanosciences et Innovation pour les Matériaux, la Biomédecine et l'Énergie (NIMBE - UMR 3685) – Commissariat à l'énergie atomique et aux énergies alternatives, Université Paris-Saclay, Centre National de la Recherche Scientifique – CEA Saclay 91190 Gif sur Yvette, France

Abstract

We propose to integrate an optimized digital microfluidic device with an induced plasma mass spectrometer (ICPMS) in order to chemically and individually characterize inorganic nanoparticles or cells. Digital microfluidics consists in creating well-defined emulsions (droplets) on a chip. For ICPMS coupling, aqueous droplets are formed in a continuous phase of volatile organic solvent that is eliminated by vaporization in the introduction system. A procession of monodisperse droplets in size, frequency and velocity is then introduced in the spectrometer and analyzed sequentially. We focus on chip design and chemical formulation. The device is based on a PDMS chip creating water or hydrochloric acid droplets inside a non-fluorinated organic solvent. The droplets are formed in a flow focusing junction: the aqueous interface is destabilized by the surrounding fluid (organic solvent) in a reproducible manner leading to a droplet formation. In some cases a second junction downstream can separate the distance between droplets. With this design and the chemical formulation chosen droplet diameter can be tuned between less than 10μm up to 50μm with frequency between 1 and 50Hz.

Keywords: digital microfluidic, single particle, single cell, hyphanated

*Speaker