Fernando Maya

Postdoctoral Researcher, Department of Chemistry, University of the Balearic Islands, Spain.

Born 1982; **Qualifications:** B.Sc./M.Sc (Chemistry), University of the Balearic Islands (2001-2007); Ph.D. (Chemistry), University of the Balearic Islands (2011); **Positions:** Postdoctoral Researcher, Lawrence Berkeley National Laboratory, USA (2011 – 2013); Postdoctoral Researcher, University of the Balearic Islands (2014-present).

Combining advanced materials with flow-based techniques for improved sample preparation

My scientific efforts have been directed towards the synthesis and characterization of novel advanced materials and their implementation in flow-based techniques for improved sample preparation.

In the development of analytical methods using flow-based techniques, the selection of an appropriate sample preparation procedure is crucial to ensure analyte quantification with proper selectivity and sensitivity. In many applications, analytes are present at low levels and in the presence of a large number of other chemical substances. In this case, a preliminary preconcentration step is required, in order to ensure analyte quantification, and simultaneously removing potential interferences from the sample matrix.

A popular sample preparation technique is Solid-Phase Extraction (SPE). SPE relies on the use of bead packings based on functional silica, or polymers. SPE is reproducible, versatile, environmentally friendly and easy to automate using flow-based techniques. SPE is typically carried out packing beads between porous frits in a cartridge of a suitable volume. The SPE method is based on four main steps including sorbent conditioning, sample extraction, washing of unretained sample components, and analyte elution.

Alternatives to classic bead packings have been explored to study the performance of novel materials as SPE sorbents using flow-based techniques, including the study of coordination polymers [1,2], carbons [3,4], or clays [5]. These materials usually do not meet the desired criteria to be used in packed mode, since their size is too small, or their shape is non-spherical.

An interesting approach to enable the use of non-conventional materials for SPE applications is their magnetization. Magnetic materials can be dispersed and retrieved from the sample, or eluent medium, by the action of an external magnetic field. In our previous work we synthesized magnetic nanoparticles in the structure of a highly porous coordination polymer, the metal-organic framework MIL-100(Cr) [1]. Highly porous magnetic carbons by the direct carbonization in an inert atmosphere of the zeolitic imidazolate framework (ZIF-67) were also prepared [3]. With this highly porous magnetic materials, different flow based SPE methods were developed enabling the fast and efficient extraction of dyes and surfactants in a fully automated mode.

Alternative approaches for the implementation of metal-organic framework materials for automated SPE were based on the fabrication of MOF-polymer disks. These disks were implemented in low-pressure flow systems and applied to the extraction of low levels of phenols from water samples [2].

Other recent research efforts have been directed towards the fabrication of low-cost sorbents for SPE. Two examples recently developed have been the automated SPE of endocrine disrupting phenols from water using carbon networks obtained from melamine-formaldehyde polymer foams [4], or the preparation of coated stir-bars with montmorillonite/epoxy resin for the automated SPE of chlorophenols from water samples [5].

My current research lines are based on the exploration of novel supports for automated SPE based on mixed-matrix membranes containing porous materials, and the incorporation of advanced materials into 3D printed polymer devices.

Selected publications:

[1] Maya, F., Palomino Cabello, C., Estela, J. M., Cerdà, V., Turnes Palomino, G. Automatic in-syringe dispersive microsolid phase extraction using magnetic metal–organic frameworks. *Anal. Chem. 87*, 2015, 7545-7549.

[2] Ghani, M., Picó, M. F. F., Salehinia, S., Cabello, C. P., Maya, F., Berlier, G., Saraji, M., Cerdà, V., Palomino, G. T. Metal-organic framework mixed-matrix disks: Versatile supports for automated solid-phase extraction prior to chromatographic separation. *J. Chromatogr. A 1488*, 2017, 1-9.

[3] Frizzarin, R. M., Palomino Cabello, C., Bauzà, M. D. M., Portugal, L. A., Maya, F., Cerdà, V., Estela, J. M., Turnes Palomino, G. Submicrometric magnetic nanoporous carbons derived from metal–organic frameworks enabling automated electromagnet-assisted online solid-phase extraction. *Anal. Chem. 88*, 2016, 6990-6995.

[4] Ghani, M., Maya, F., Cerdà, V. Automated solid-phase extraction of organic pollutants using melamine–formaldehyde polymer-derived carbon foams. *RSC Adv. 6*, 2016, 48558-48565.

[5] Ghani, M., Saraji, M., Maya, F., Cerdà, V. Automated multisyringe stir bar sorptive extraction using robust montmorillonite/epoxy-coated stir bars. *J. Chromatogr. A 1445*, 2016, 10-18.