Design of hybrid monolithic materials modified with nanoparticles: Application to the separation of small solutes and bio-macromolecules

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Along the last years, monolithic porous polymers have been widely investigated as stationary phases for separation techniques. Advantages are ease of preparation, high permeability and a vast variety of easily modifiable surface chemistries. Nevertheless, these monoliths have low surface areas due to the lack of an adequate mesoporous structure. Adverse consequences are low retention and reduced sample load capacity. The development of hybrid materials containing nanoparticles (NPs) has opened promising ways of overcoming these limitations, also enormously expanding the available monolith classes. We have work with two approaches, namely to modify the surface of methacrylate monoliths with covalently bonded NPs (I), and to obtain monoliths by copolymerization with derivatized NPs (II). Concerning approach I, the surface of monoliths was first modified with thiol-containing ligands, thus to be able of bonding silver NPs (AgNPs) on them. Monoliths with very large reactive surfaces resulted. The bonded AgNPs showed a large capacity of strongly retain thiol-containing analytes. Further, the retained analytes were easily eluted by replacement with compounds also containing thiol groups if present in excess in the mobile phase. Application to the pre-concentration of thiol-containing compounds (glutathione, N-acetylcysteine, peptides and proteins) in biological fluids and food was demonstrated. Regarding to approach II, iron oxide NPs were first silanized with a vinyl-containing reagent. The resulting vinylized NPs were copolymerized with methacrylate monomers to render a monolith with a rough surface. This monolith exhibited enhanced retention of a variety of molecules (e.g., organophosphorus pesticides), as well as an improved efficiency.

Biography
José Manuel Herrero-Martínez obtained his PhD in Chemistry at the University of Valencia, Spain, in 1996. He worked in teaching and research at the Universities of Amsterdam and Barcelona. Since 2009, he is working as an Associate Professor in the Department of Analytical Chemistry at the University of Valencia. His research interests focus on the development of polymeric materials, in particular polymer monoliths, with application in separation science.

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