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Superparamagnetic Iron Oxide Nanoparticles (SPIONs) as Cores for Molecularly Imprinted Polymers (MIP) in Trace Analysis

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Abstract **-** The following article presents an effective method of core-shell systems preparation, utilizing superparamagnetic iron oxide nanoparticles (SPIONs) as the core. In this research, various molecularly imprinted polymers (MIP) were used as the shell. Obtained system combines magnetic properties of the iron oxide nanoparticles and selective analytical properties of the polymeric coating. Resulting magnetic molecularly imprinted polymers (mag-MIP) were used for initial concentration and trace analysis of organic compounds in environmental samples. SPIONs modified with TEOS (tetraethoxysilane) and MPS (3- (trimethoxysilyl) propyl methacrylate) were used as a magnetic core. EGDMA (ethylene glycol dimethacrylate) and AIBN (2,2'-azobisisobutyronitrile) were used as a crosslinking agent in thermal polymerization. Different classes of compounds were used as polymer matrices: flavonoids, herbicides, pesticides, hormones, for which the appropriate monomers were selected. Mag-MIP was successfully used to determine all tested chemicals in environmental samples. Trace amounts of analytes were adsorbed from their solutions onto the surface of functionalised SPIONs. Subsequently, mag-MIP were attracted by magnets immersed in the solutions and analysed *via* electrospray ionization mass spectrometry (ESI-MS) and flowing atmospheric pressure afterglow mass spectrometry (FAPA-MS) combined with thermally initiated desorption. Mag-MIP combined with FAPA-MS is a novel analytical method suitable for trace detection from highly heterogeneous solutions. The combination of an analyte pre-concentration with mag-MIP followed by FAPA-MS analysis significantly reduced limit of detection (LOD) for all trace analyses.

Keywords**:** nanomaterials, superparamagnetic iron oxide nanoparticles (SPIONs), Fe_3O_4, molecularly imprinted polymers (MIP), magnetic molecularly imprinted polymers (mag-MIP), sample pretreatment, trace analysis, flowing atmospheric-pressure afterglow mass spectrometry (FAPA-MS).