Synthesis and application of ion imprinted modificated SBA-15 materials in analytics of selected noble metals

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Summary of Doctoral Thesis

Widely applied of noble metals in many fields of technology and industry results in a significant increase in their content in the natural environment. These elements under the influence of high temperatures, chemical reactions and in the presence of appropriate ligands can be converted into compounds with high bioavailability and toxicity to humans. Therefore, it is extremely important to control the content of noble metals in individual components of the ecosystem. Determination of noble metals in real samples is usually carried out using graphite furnace atomic absorption spectrometry (GF AAS). Unfortunately, the low concentration of noble metals and the presence of other elements in a large excess, results in numerous interferences and make direct determinations impossible. Therefore, preconcentration and/or separation step prior to determination of noble metals is necessary. This task can be accomplished by means of extraction methods, especially by means of solid phase extraction (SPE), which base on ions adsorption from the liquid phase on a solid sorbent. In the SPE technique, the selection of a sorbent with appropriate properties is extremely important. Of all the sorbents used in solid phase extraction, ion imprinted mesoporous organosilica materials deserve special attention. They have the advantages of modified SBA-15 materials, such as the simplicity of synthesis, high thermal resistance or large specific surface area, and additionally the introduction of imprint ions provides a significant increase in affinity and selectivity for imprinted metal ions.

The aim of the doctoral dissertation were the synthesis and physicochemical characterization of Pt(IV), Pt(II), Pd(II) and Au(III) ion imprinted SBA-15 materials modificated by alkoxysilane containing the thiocyanato groups and evaluation of their suitability for initial separation and preconcentration of platinum, palladium and gold from solutions obtained after mineralization of geological samples.

Investigation included a sol-gel one-step synthesis of SBA-15 materials modified with thiocyanatopropyltriethoxysilane (TCTES), in the presence of a imprinted ion using different molar ratios of tetraethoxysilane and modifying monomer and various amounts of imprinted ions, then leach out of the noble metal ions was performed. Obtained materials were analyzed using XRD, XPS, FTIR and SEM techniques, and their isotherms of low temperature nitrogen adsorption/desorption were determined, thanks to this the influence of modifying monomer and imprinted ions amounts on the morphology and structural parameters obtained materials was determined. A series of model tests were also carried out to determine the applicability of the obtained materials in Au(III), Pt(IV), Pt(II) and Pd (II) preconcentration and/or separation processes from solutions obtained as a result of acid mineralization of geological samples.

The results of the investigation allow for the conclusion that, materials with ion imprinted are characterized by a higher adsorption capacity and better selectivity towards to imprinted metal ions than control materials. Moreover, in the case of ion imprinted materials, the time required to establish the adsorption equilibrium is shorter than in the case of control materials. The analysis of the research results made it possible to develop analytical

procedures enabling the determination of platinum, palladium and gold in real geological samples. The methods were validated by analyzing certified reference materials, and results were in good agreement with certified values. The procedures were successfully applied to the separation and determination of gold, platinum and palladium in complex geological samples.