

NOVEL COLORIMETRIC CHEMOSENSOR FOR SIMULTANEOUS DETERMINATION OF SILVER(I) AND PALLADIUM(II)

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The development of simple methods for rapid control of analytes represents one of the actual trends of modern analytical chemistry. Sorbents and test-systems based on xerogels (XG) of silicic acid modified by organic reagents are commonly used for the preconcentration and determination of noble metals (NM). Mélange-gel technology (MGT) has been recently suggested as an alternative to sol-gel method. MGT can be applied for the immobilization of most organic reagents, regardless of their solubility in water, structure and degree of hydrophobicity. The method is efficient, simple and cost-effective. It does not require expensive equipment, long-term purification or synthesis.

MGT was used to immobilize 3-phenyl-2,6-dimercapto-1,4-thiopyrone (PhDT) into XG prepared from liquid glass. One of the main stages of mélange-gel process is micellar extraction of organic reagent into a surfactant-rich phase (Triton X-100) at a cloud point temperature (CPE). It was established that different forms of PhDT are extracted with surfactant-rich phase: protonated in 2 M HCl and deprotonated at pH 4. Sorption isotherms for Pd(II) and Ag(I) have H-form. However, S-type of isotherm was obtained for Pd(II) at pH 4. In this way, the conditions were found for the determination of Pd(II) and Ag(I) without preliminary separation: in 2 M HCl for Pd(II) and at pH 4 for Ag(I). The obtained sorbent based on XG and PhDT was used for the simultaneous, sensitive and selective colorimetric determination of Ag(I) and Pd(II). The 100-fold excess of Ag(I) does not interfere with the Pd(II) determination when reaction proceeds in 2 M HCl.

The prepared sorbent was used as an indicator powder, from which the tablets were formed. Such a method guarantees excellent reproducibility of sorbate color intensity and RGB data. The developed chemosensor was applied to the simultaneous determination of micro quantities of Pd(II) and Ag(I). By using 20 ml of sample solution, the detection limit for Pd(II) and Ag(I) was 15 and 10 ng mL⁻¹, respectively.

The dependence of RGB color coordinates on Pd(II) content is characterized by an exponential function ($r^2 = 0.999$) for the concentration range from 0.02 to 0.64 $\mu\text{g mL}^{-1}$. For Ag(I), the obtained curve can be approximated by linear dependence in the range from 0 to 0.10 $\mu\text{g mL}^{-1}$ ($r^2 = 0.998$). The proposed chemosensor can be successfully used for Ag(I) detection in contaminated waters considering the requirements to drinking water quality and maximum permissible silver concentration of 15 $\mu\text{g L}^{-1}$.