Summary

"Nanoengineering of SERS substrates using metallic nanoparticles produced by the reduction method with α-amino acids"

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In recent years, numerous studies have focused on applications of surface-enhanced Raman spectroscopy (SERS) in the detection and identification of trace amounts of chemical substances. A crucial issue for SERS applications is the choice of SERS substrates. This work presents the results of comparative studies on the fabrication of substrates for SERS applications, in which the main components were metallic nanoparticles (NPs) produced by the reduction of metal salts using α-amino acids (α-AAs) and glass and silicon supports. The use of readily available components aimed to fabricate effective yet inexpensive and straightforward SERS substrates. In my work, I attempted to prove the thesis that "metallic nanoparticles obtained by reduction of metal with salts of α-AAs can serve as an effective enhancing layer in a SERS substrate, enabling detection of trace amounts of chemical substances." In the research, as reducers and stabilizers in the synthesis of Au NPs, I used salts of 20 proteinogenic and one non-proteinogenic α-AA, analogous to the use of sodium citrate in the Turkevich method. Au NPs were obtained in syntheses using 17 of the 21 tested α-AAs. The proposed modification of the Turkevich method was also tested in the synthesis of Ag nanoparticles. Combining Au NPs obtained with five selected α-AAs and four types of platforms (smooth and rough) yielded 17 potential SERS substrates, which, together with their components, were characterized by microscopic and spectroscopic techniques. The effectiveness of the produced substrates in SERS was evaluated using 4-mercaptobenzoic acid and 1,2-bis(4-pyridyl)ethylene as probe molecules. The studies showed that not all Au NPs synthesized with α-AAs can serve as an effective enhancing layer in SERS substrates. The surface chemistry of Au NPs influences the fabrication and performance of SERS substrates. Among the active SERS substrates produced, the highest enhancement factors were estimated for substrates fabricated using Au NPs synthesized with L-serine.

Keywords: SERS substrate, metallic nanoparticles, α-amino acids, Turkevich method

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