KCL CONCENTRATION EFFECTS ONTHE FORMATION, STABILITY, AND SERS SIGNAL STRENGTH OF LASER-GENERATED GOLD,SILVER, AND HYBRID NANOPARTICLES

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Nanoparticles of noble gold and silver metals have attracted major interest due to their optical, electronic, and catalytic properties, which are linked to the localized surface plasmon resonance (LPPR) phenomenon. Due to their unique properties [1], they are used in sensors, biological applications, Surface Enhanced Raman Scattering (SERS) [2], catalysts, nanotechnology, labeling, and electronics. The generation of noble metal nanoparticles has been extensively studied. Various techniques have been developed, including chemical reduction, electrochemical deposition, sol-gel processes, and laser ablation [2, 3]. Of these methods, laser ablation has gained momentum as a clean and environmentally friendly method of producing nanoparticles without the need for additional purification of toxic materials. However, one of the problems associated with laser ablation is the tendency of nanoparticles to aggregate, which limits further applications. To avoid particle aggregation, additional materials are added that contaminate otherwise clean method. Therefore, we tested a biocompatible material, potassium chloride (KCl). Salt is known to promote aggregation [4]. However, studies have shown that low salt concentrations can slow down the aggregation process [5]. These threshold concentrations were analyzed in this work.

In this study, the aggregation rate and extinction of gold, silver, and a mixture of nanoparticles formed in different concentrations of KCl solutions were studied over a period of 8 weeks. Gold and silver nanoparticles were generated from bulk targets immersed in 20 ml of different concentrations of KCl salt solutions: 0 mM to 20 mM. The targets were treated with a focused Nd:YAG laser ("Ekspla Baltic1064 HP", 1064 nm, 10 ns pulse duration). Extinction spectra and photographs of the resulting colloidal solutions were recorded weekly. Particle morphology, SERS signal strength, and zeta potential were also analyzed.

All particles formed by laser ablation in water and salt solution were characterized by a spherical shape and a negative zeta potential (-16 mV to 58,8 mV). During the study, we found optimal concentrations of KCl salt to maintain a stable solution without significant spectral deviations.

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