

STUDY OF THE TEMPERATURE INFLUENCE ON THE GEOMETRY OF THE SILVER NANOPARTICLES DURING POLYOL SYNTHESIS

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Metal nanoparticles with different sizes and shapes have broad spectrum of application including localized surface plasmon resonance (LSPR), surface enhanced Raman scattering (SERS) [1], sensors, optical probes, catalysts [2]. The polyol synthesis route allows to obtain nanoparticles of various shapes and sizes. Size and shape of the nanoparticles mainly depends on the synthesis temperature, precursors, synthesis time [2,3].

Polyol synthesis is simple chemical reduction method where the medium of reaction is multivalent alcohols [4]. The main advantage of this synthesis is that variety of polyols can be used and simplicity - it does not require very expensive materials to obtain particles of normative size by chemical reduction in a short time.

In this research, polyol synthesis was used to synthesize silver nanostructures. The precursor was silver nitrate, copper chloride was used as etchant and polyvinylpyrrolidone – as capping agent. All reagents were dissolved in 1,5 – pentanediol. The reaction took place in a heated vial with 1,5-pentanediol repeatedly injecting AgNO₃ and PVP solutions. These two solutions were injected repeatedly in a hot flask with 1,5-pentanediol. The process took about 15 minutes in average until the solution in reaction flask became opaque. The final solution was left to cool down in a room temperature and optical properties were measured (Avantes, 190-1100 nm, resolution 1.4 nm). The influence of synthesis temperature to the yield and geometry of nanoparticles was investigated in a range of 125 – 155°C.

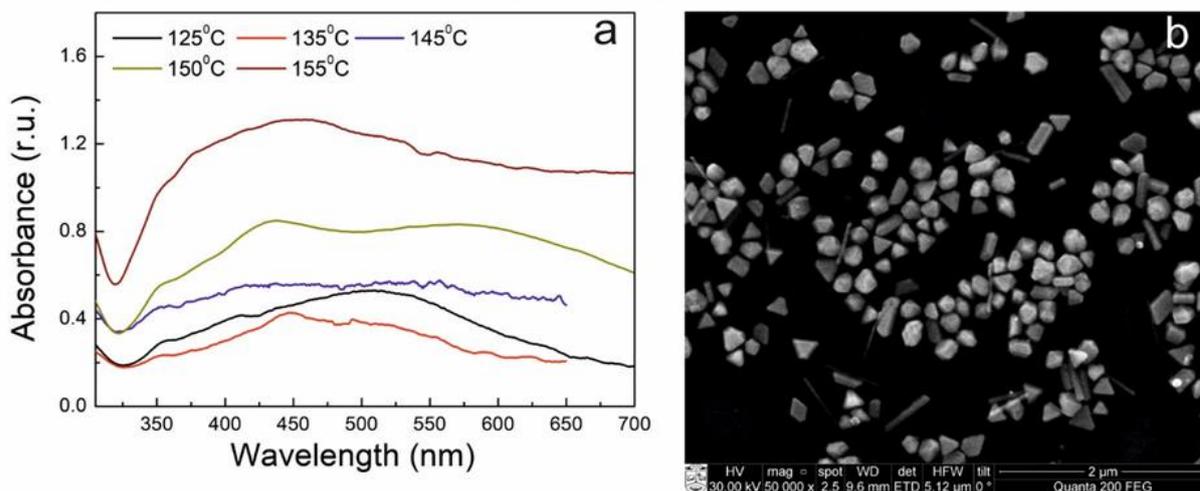


Fig. 1. UV-VIS spectra of nanoparticle solutions synthesized at different temperatures (a) and corresponding SEM image of nanoparticles synthesized at 155°C

The effect of the temperature on the optical properties of colloidal solution is shown in Fig. 1 (a). It was found that in all used temperature range, silver nanostructures were formed as characteristic surface plasmon peak was observed. Only at 145°C temperature the peak is not so well expressed (due to broad size distribution). From the absorption spectra of the nanoparticles synthesized at 125 °C and 150 °C two main peaks were identified – at the 420 nm and 510 – 600 nm with shoulder at 350 nm. That is an indication of synthesized particles with sharp edges [5]. Analysis with SEM has proved our conclusion from UV-VIS spectra (Fig. 1 (b)). From the SEM image one can see that there are different shape particles and some of those are single crystalline particles and some – multiply twinned.

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