

PREPARATION OF SILVER NANOPARTICLES IN SILVER NITRATE SOLUTION BY USING TANNIN

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Abstract: Tannin was used as a reductant and sodium carbonate as a solution stabiliser to create silver nanoparticles in a silver nitrate solution. The production of silver nanoparticles was examined using spectrophotometric and electron microscopy techniques. Researchers looked at how different levels of microwave power affected nanoparticle production.

Keywords: electrolyte, tannin, sodium carbonate, silver nanoparticles, and microwave radiation.

Introduction

The unique antibacterial, optical, and sensor capabilities of silver nanoparticles make them useful in many fields, including electronics, medicine, and optics and sensors. The most common chemical technique for producing silver nanoparticles is forming them in a water solution with a variety of reductants and stabilisers. One, two Reductants frequently include toxic chemicals like hydrazine and sodium borohydride. Consequently, improving the process of making silver nanoparticles using safe ingredients is a pressing matter. Combining chemical procedures with exposure to high-energy physical fields, including microwave electromagnetic ones, yields very effective results. Raising the temperature is a common way to speed up chemical processes, as is well known. Traditional techniques of heating solutions include a slow transfer of heat by convection, radiation, or heat conduction, which always results in the formation of a temperature gradient. The instantaneous heating of the whole solution occurs upon exposure to microwave radiation.^{3,4}

Experimentals

As a source of carbonate ions, sodium carbonate served as a stabiliser, while tannin acted as a reductant. The solution was diluted using distilled water. We let the solution sit at room temperature

while we made it. Silver nitrate solutions were supplemented with sodium carbonate and tannin solutions (10-5M).

Optical imaging device based on electron scanning The electron microscopy analysis was performed using Jem100-SX.

Results and Discussion

The silver nanoparticles prepared in silver nitrate solutions using tannin as reducing agent and sodium carbonate as source of carbonate ion as stabilizer were performed at pH=5.77. The exposure to microwave irradiation was 4min. The UV-Vis spectra of the reaction mixtures formed with or without microwave irradiation contain well-defined plasmon bands with a peak at 420 nm, which is characteristic of silver nanoparticles (Figures 1 and 2).

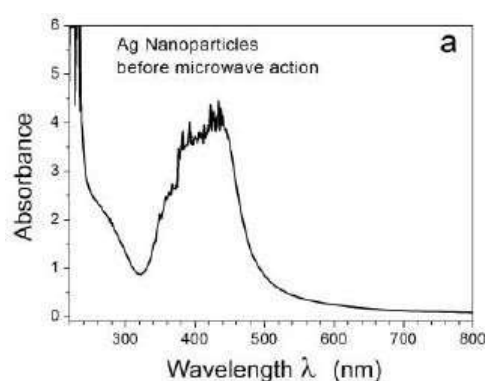


Figure 1. Absorption spectra of silver nanoparticles in silver nitrate solution $5 \cdot 10^{-3} \text{ M}$

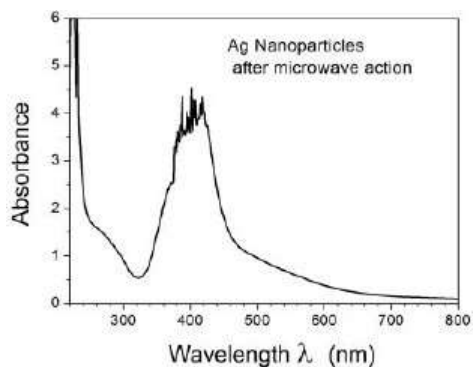


Figure 2. Absorption spectra of silver nanoparticles in silver nitrate solution (10^{-3} M) after the exposure to the microwave field.

The resulting nanoparticles were found to be crystalline, as seen in Figure 3. Figure 4 displays the distribution of nanoparticle sizes prior to microwave activation. Nanoparticle solutions often comprised spheroids 15–20 nm in size, as shown in the microphotographs. Also noticed were a few of bigger nanoparticles, measuring 30–40 nm in diameter.

Figure 3. Electron-microscopic microphotograph of silver nanoparticles before the exposure to the microwave field.

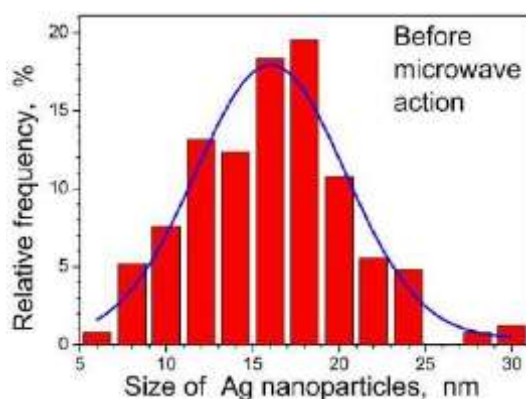


Figure 4. Size distribution of silver nanoparticles before the exposure to the microwave field.

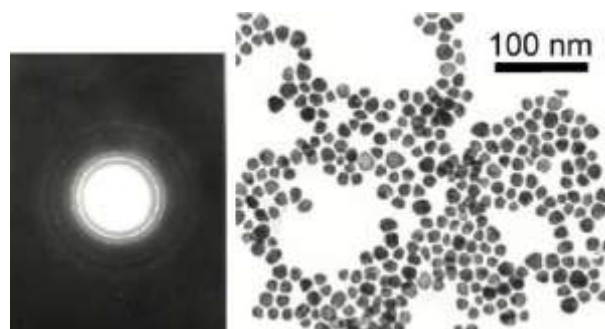


Figure 5. Electron-microscopic microphotograph of silver nanoparticles after the exposure to the microwave field.

The Electron-microscopic investigation performed after the exposure of the samples to the microwave field showed that there had taken place changes in the shape and size of the nanoparticles (Figure 5). The size of nanoparticles reduced and made up 10–15 nm. To analyze the size distribution of nanoparticles, we constructed relevant histograms. It is seen that, after the exposure to the microwave field, the nanoparticles were distributed within a much narrower size range than before it (Figure 6).

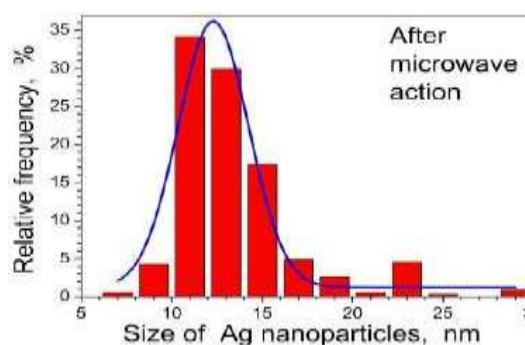


Figure 6. Size distribution of silver nanoparticles after the exposure to the microwave field.

The experiments showed that sodium carbonate possessed good stabilizing properties. The prepared solution of silver nitrate containing silver nanoparticles retained its properties during a month, and there was no aggregation.

Conclusions

The production of silver nanoparticles using tannin as a reductant and sodium carbonate as a solution stabiliser showed promise. The results revealed that sodium carbonate was an effective stabiliser, and that the synthesised silver nanoparticle with a silver nitrate solution kept its characteristics for a month without aggregation. We have developed a technology that eliminates the need for costly and environmentally hazardous chemicals

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