

Effect of PVP Molecular Weight on Synthesis of Silver Nanoparticles

Nairobi Ballard, CRESH Student, White Station High School

Mentor: Dr. Sanjay Mishra, Ph.D. Department of Physics, University of Memphis, Memphis, TN

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Introduction

Since ancient times silver has been used for a host of ailments from fighting infections and controlling spoilage to dentistry and burn wounds; even added to lubrication oil and as a catalyst. This antibacterial agent is powerful in its simplest form, however the condensing of silver ions and silver based compounds boosts its antibacterial activity. The smaller the silver atom the more antibacterial it is, scientists found this after making silver ions on the nanoscale. Polyvinylpyrrolidone (PVP) is a synthetic polymer used as a reducing, dispersing and suspending agent. PVP is also biocompatible.

Rational

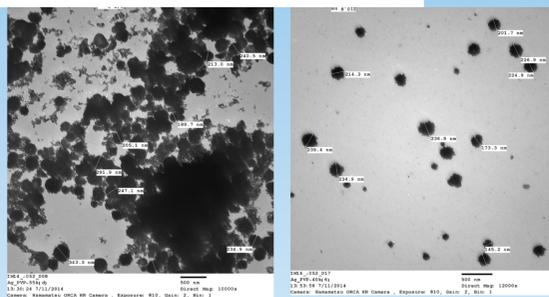
In this study we will be investigating the effects of varying PVP molecular weight on the growth of silver nanoparticles.

Materials and Methods

Materials: For the synthesis of silver nanoparticles silver nitrate, deionized water, acetone, and polyvinylpyrrolidone (PVP) of varying molecular weights of 10,000, 29,000, 40,000, and 55,000 were used.

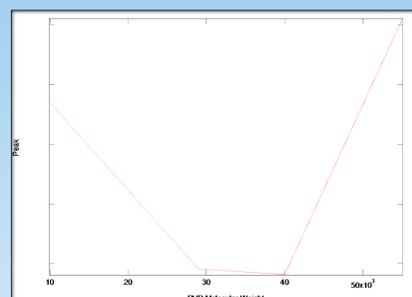
Method: The method used to make the silver nanoparticles began with the adding of 5 ml of deionized water into four beakers, then measuring out 50 milligrams of silver nitrate and dissolving it that to the deionized water. The beakers were then placed on magnetic plates and stirred using magnetic stirrers until the silver nitrate dissolved. Then 40 milliliters of acetone was measured and added into the silver nitrate solutions. Once the acetone was mixed into the solutions, it was stirred for 20 minutes before 2 grams of PVP was added to each of the four beakers. The solutions were stirred for 35 minutes during which the dark brown solute formed. The remaining acetone and nitrate solution was then decanted and the dark brown substances were placed under the fume hood to dry for a duration of 48 hours. The dark brown substance was sticky in the middle, but hardened on the edges of the beaker

TEM images



Images of silver nanoparticles synthesized using PVP

UV-Vis Peaks



UV-Vis Peak Points

Results

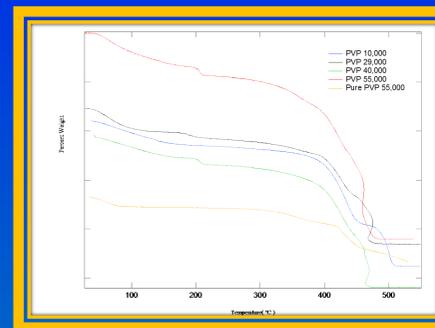


Figure 6 - Curve of the TGA thermogram of AG/PVP nanoparticles showing weight loss.

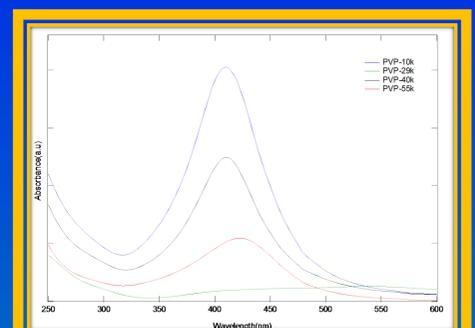


Figure 5 - UV-Vis absorption spectra for different molecular weights of PVP in AG/PVP nanoparticles.

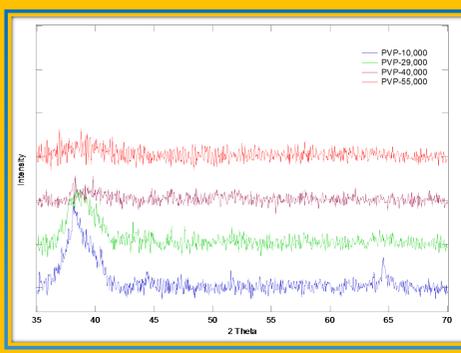


Figure 2 - XRD patterns of AG/PVP nanoparticles of different molecular weight.



Figure 1 - Different PVP molecular weight AG/PVP nanoparticles dissolved in ethanol.

Discussion

Figure 2 shows the XRD patterns of the four synthesized samples. The patterns show the presence of pure silver. The silver peaks broadened with increasing PVP molecular weight, which indicate decrease in Ag particle size. This is due to decreased mobility of Ag ions in dense PVP matrix. TEM images, Figure 4, show growth of spherical Ag NPs in the size range of 200 nm.

Shifting of UV-vis peak, Figure 3., to lower wavelength indicate growth of smaller Ag NPs with increasing PVP -MW. Figure 1 show color variation due to size variation of Ag NPs.

TGA plots indicate that pure PVP degrades at around 450 °C. But the addition of Ag NPs to PVP increases the decomposition temperature to 500 °C. Furthermore, decomposition temperature of Ag-PVP composite decreases with the decrease in Ag-particle size in the composite.

CONCLUSION

Overall the result of this study shows that smaller Ag NPs are formed in the denser PVP matrix. This is because of low mobility of Ag ions in dense polymer matrix. Interestingly, Ag-PVP showed higher decomposition temperature as compared to pure PVP.

References

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Acknowledgements

I would like to first thank my extremely supportive parents, Reuben and Rochelle. I thank my mentor Dr. Mishra and graduate researcher, William Armstrong for guiding me through this program. I would lastly like to thank Dr. Sabri for giving me the opportunity to be apart of this learning experience.