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IONIC STRENGTH AND PH: A LOOK AT NANOSTAR STABILITY

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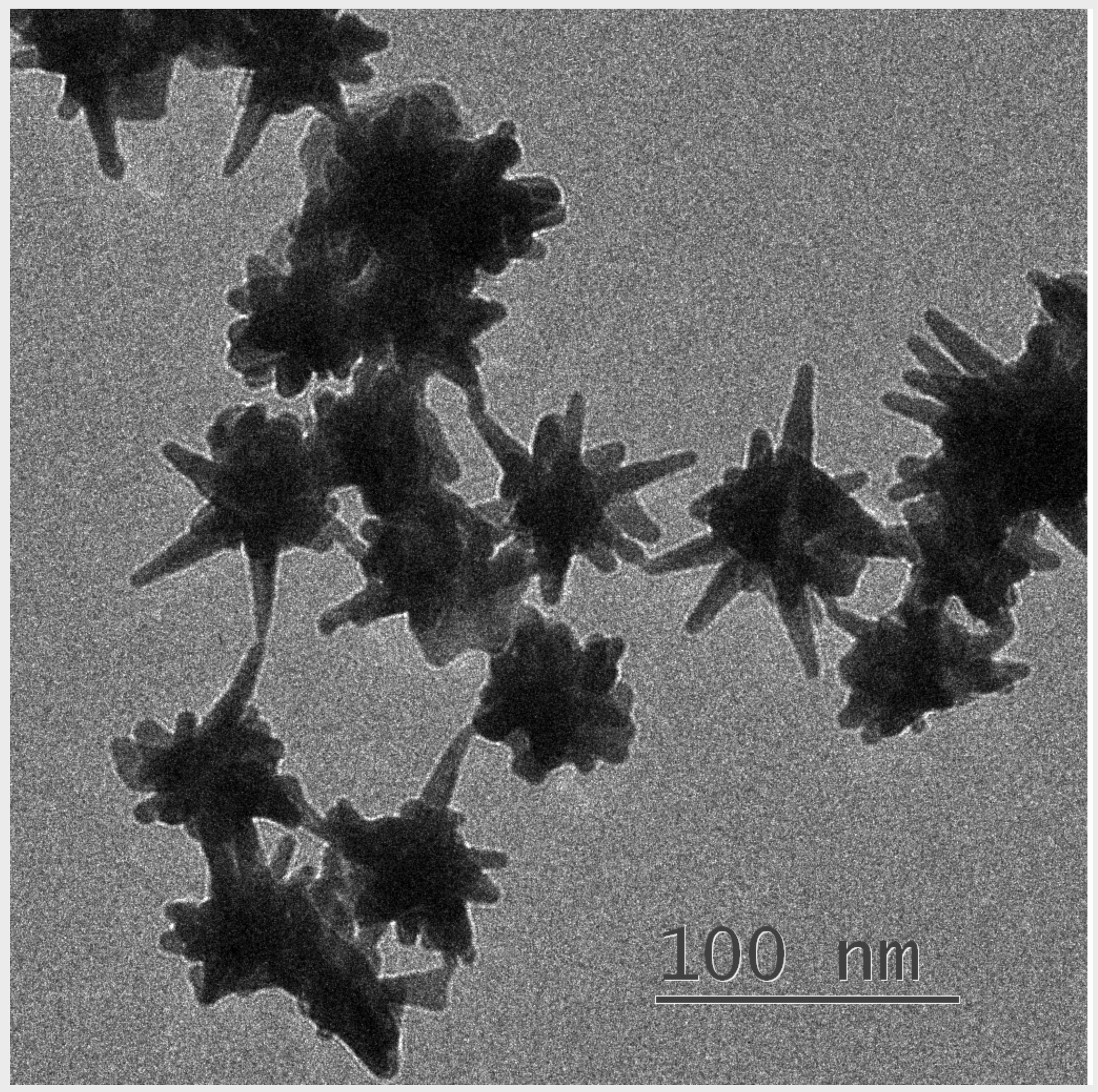

Figure 1. TEM image of nanostars. The interactions between light and electrons on the surface of the nanostars create localized surface plasmon resonances (LSPRs). The LSPRs show up as a peak in the UV/Vis absorption spectrum so they can be seen by running the suspension containing nanostars through a UV/Vis spectrophotometer.

1. ABSTRACT

Nanostars have many potential applications, particularly in biomedicine, such as drug delivery, detection assays, and even cancer treatment. Seeing how their plasmon changes in response to changes to the environment of the nanostars can give us an insight to the stability of the nanostars. Our current studies involve the effect of ionic strength, pH, and time on stability.

2. INTRODUCTION

Stability being an important condition of the usefulness of nanostars, we wanted to determine how the potential environments a nanostar could be used in affected them, especially as they pertain to biocompatibility. Biocompatible nanostars are important because they have the potential to fit inside cells.[1] Peak plasmon wavelength, λ_{max}, and optical density at maximum, OD_{max}, information can be obtained from from the UV/Vis spectrum of nanostar suspensions which is important because we use them, especially λ_{max}, to determine stability.

3. METHODS

We begin with the synthesis of several batches of nanostars at 5°C. The synthesis process employs a seed-mediated, surfactant free approach to grow the nanostars. The final suspension was analyzed with a UV/Vis spectrophotometer. This UV/Vis data was used to ensure that the optical densities of the samples were the same. For the ionic strength study, the samples contained varying levels of salt concentration. The pH study involved altering the pH of the nanostar suspension. Lastly, the time-effect study has us looking at how time affects the stability of nanostars. All samples are run through a UV/Vis spectrophotometer.

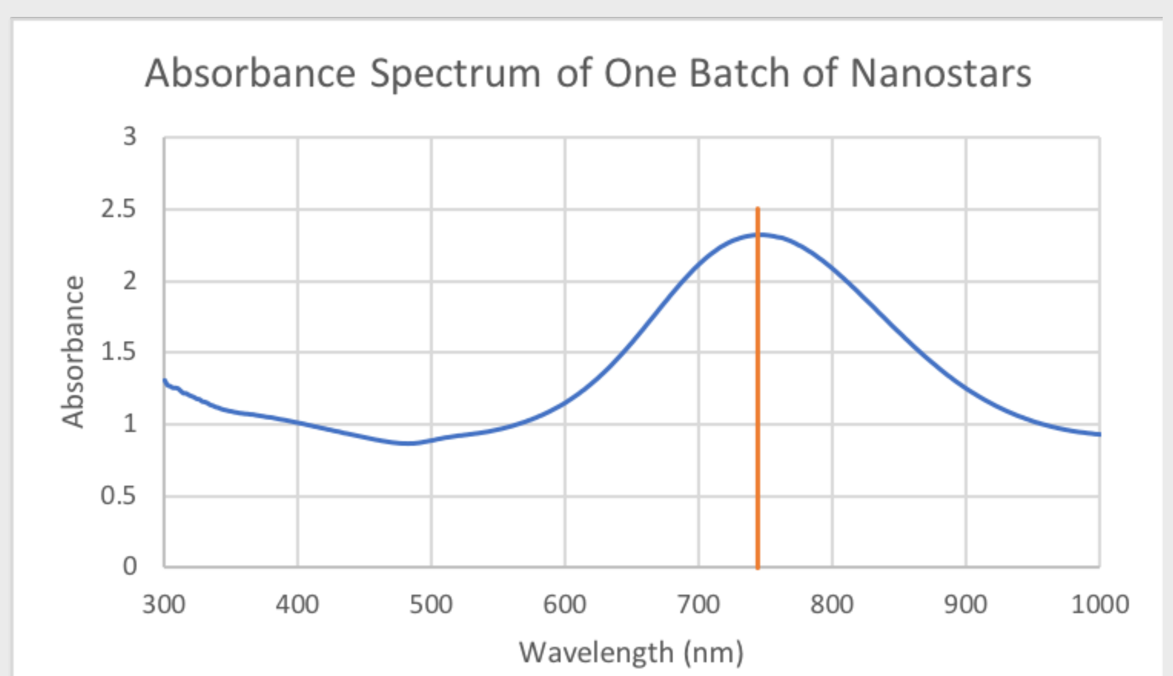

Figure 2. The UV/Vis spectrum of one batch of nanostars synthesized at 5°C showing the λ_{max} at 746 nm and an OD_{max} of 2.327. Nanostar usefulness requires a reproducible peak plasmon wavelength, λ_{max}, which is dependent on both the size and shape of the nanostars.[2] For this reason, we synthesize nanostars at 5°C because it has been shown that synthesis at this temperature exhibits the greatest reproducibility of the plasmon.[2]

4. RESULTS AND DISCUSSION

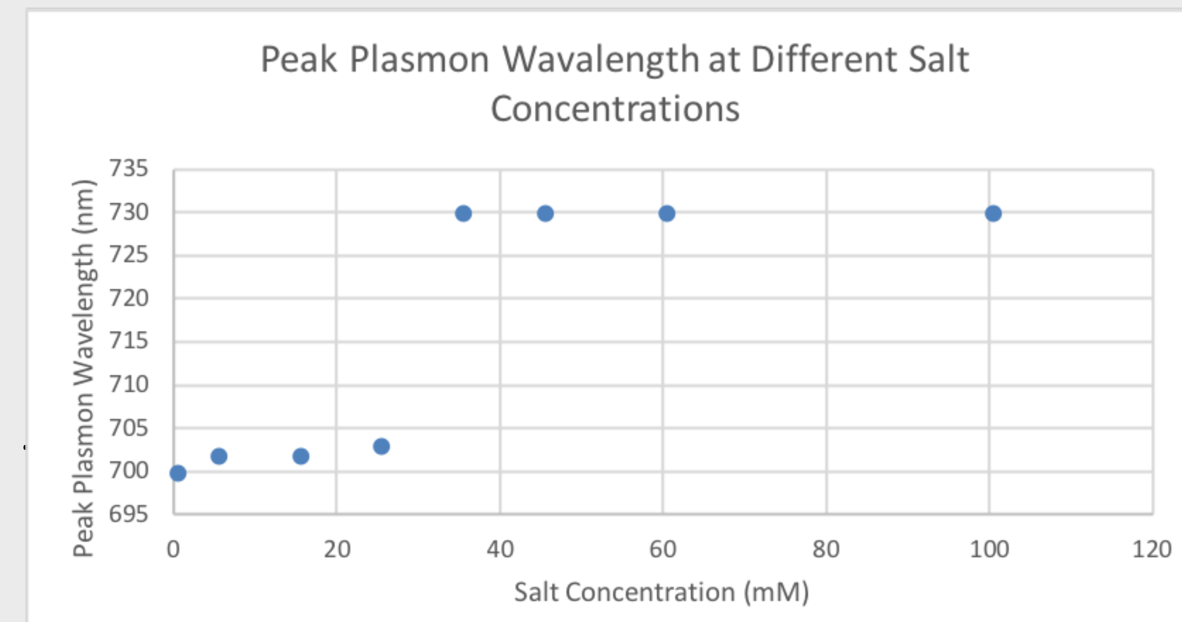

Figure 3. Summary of ionic strength data showing that at higher salt concentrations, the peak plasmon wavelength redshifts.

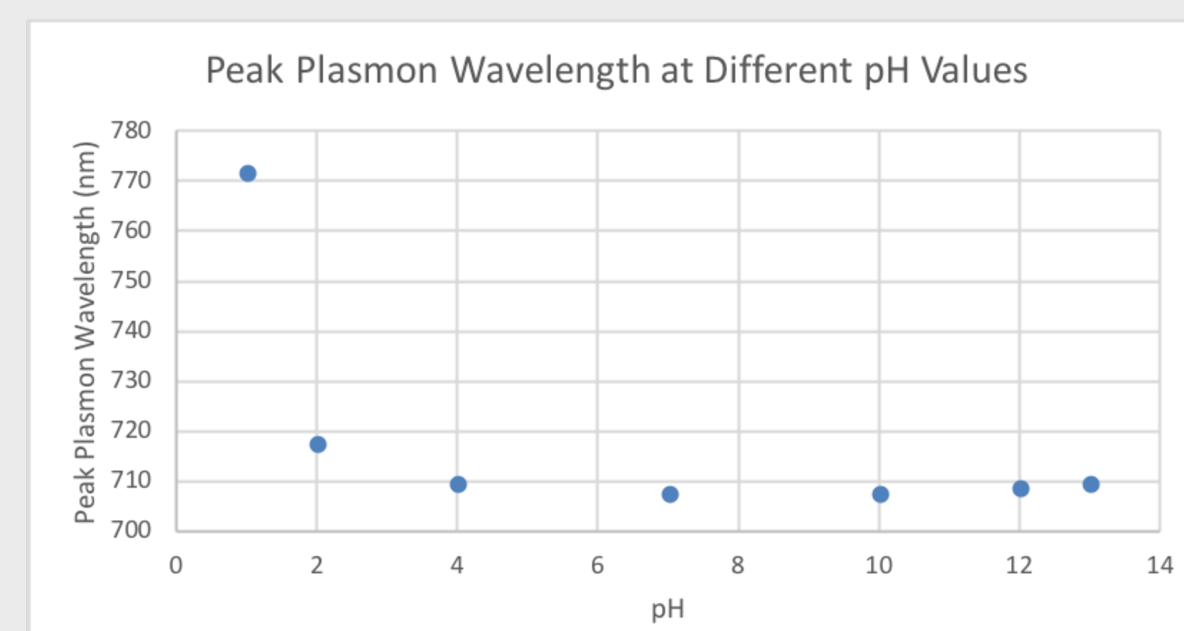

Figure 4. Summary of pH data showing that at a very low pH, there is a redshift of the peak plasmon wavelength.

Knowing that changes in the plasmon in response to high salt concentrations and low pH conditions can inform our practical use of nanostars. If these conditions decrease stability, then it makes sense that we probably shouldn't use them in situations where high salt concentration or very low pH exist. We aren't completely done with the time effect study, but we expect to see a blue shift i.e. a decrease in λ_{max}. While this will most likely happen naturally no matter what, the question is how long before we see the changes in the plasmon. Knowing how time affects the stability of nanostars gives us an idea about things like shelf life. Shelf life is something that would be important for nanostar suspensions because it would mean that the whole synthesis process and any other alterations to the suspension would not have to be done every time the nanostars were needed.

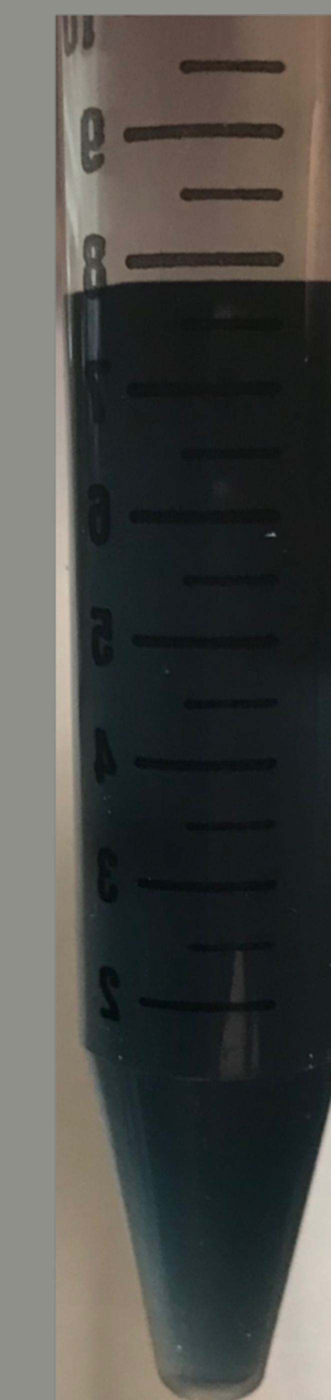

Figure 5. A nanostar suspension after synthesis at 5°C. This suspension is analyzed with a UV/Vis spectrophotometer. Magnifying this by several thousands of times is how you would see the structure and geometry of the nanostars.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

1. H. Yuan, C. G. Khoury, H. Hwang, C. M. Wilson, G.A. Grant, & T. Vo-Dinh, *Nanotechmology*, 2012, **23**, 075102.
2. Ramsey, J., Zhou, L., Kyle Almlie, C., Lange, J., & Burrows, S. (2015). Achieving plasmon reproducibility from surfactant free gold nanostar synthesis. New Journal of Chemistry, 39(12), 9098-9108.

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