Exploration of Plasmonic WO_{3-X} Nanocrystals Through Various Microwave Methods

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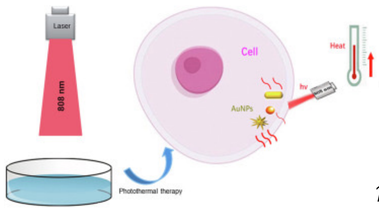
Introduction

Nanoparticles are an emerging field in the world of chemistry with their distinct features and applications. There are various methods to synthesize and clean nanoparticles. In synthesizing WO_{3-x} nanoparticles[1] we investigate various synthesis and microwave methods as well the impact they made on the observed Localized Surface Plasmon Resonance (LSPR) and full width at half max (FWHM). We tested various microwave conditions such as open to air vs closed to air and constant power vs pulsing[2] and their adequacy in having a visible LSPR. With this research, we will know more about effectively using nanoparticles for application in various fields such as biomedicine, materials chemistry, and more.

Background

Photothermal Therapy



[3] Yang, W. et al., Materials Today Sustainability., 2021

The Drude Model

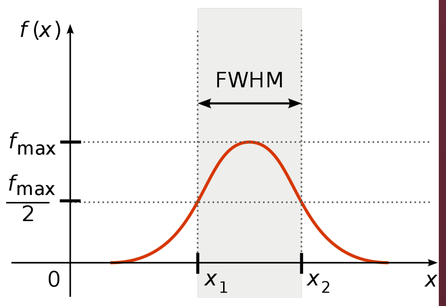
$$\omega_\rho = \sqrt{\frac{ne^2}{\varepsilon_0 m^*}}$$

$n \rightarrow$ carrier density

$m^* \rightarrow$ carrier effective mass

FWHM model

FWHM shows the "damping" effect of the impurities in our nanocrystals



[5] Nordmann, A., Own Illustration, 2007

Results

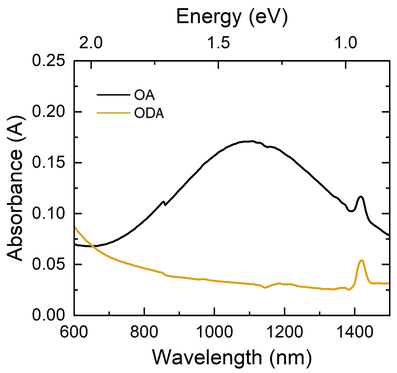


Figure 1. The difference between a UV-VIS scan for oleic acid vs octadecylamine

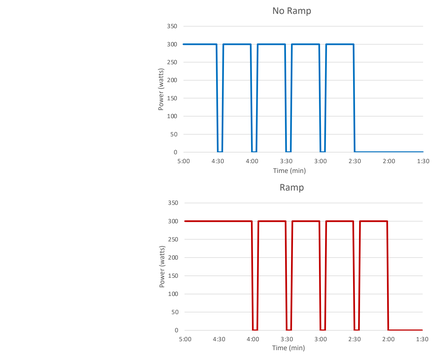


Figure 2. The difference between a no ramp and a with ramp run

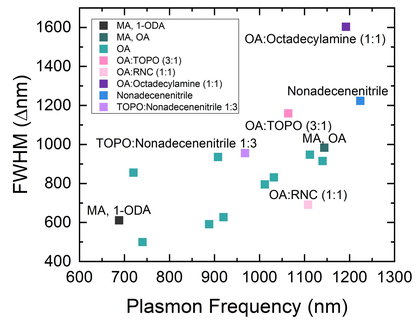


Figure 3. Multiple samples all made of different ligands plotting FWHM over plasmon frequency

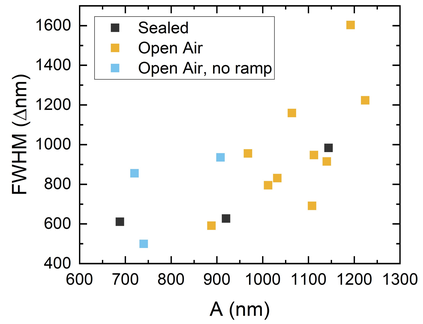


Figure 4. Multiple samples all microwaved under different conditions plotting FWHM over plasmon frequency

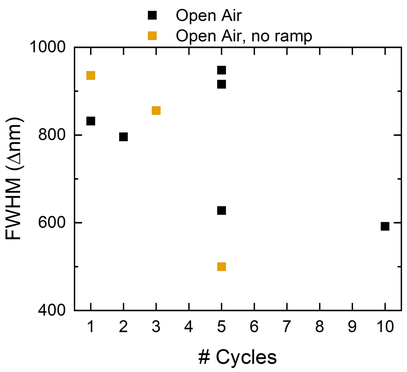


Figure 5. All open-air samples separated by whether it had a ramp or not plotting the FWHM

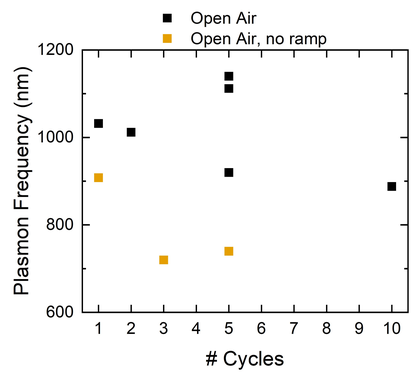


Figure 6. All open-air samples separated by whether it had a ramp or not plotting the plasmon frequency

Discussion

Using Oleic Acid as our main ligand has proven to produce these approximate results

When pulsing our samples, we see ideal FWHM and plasmon frequencies, compared to when they run on constant power

Additionally, we see our best samples when we leave them open to air with no ramp

Overall, to achieve a low FWHM range of 500-1000 and plasmon frequency range of 500-900 our best conditions are to use Oleic Acid and to leave them open to air while pulsing them with no ramp

Acknowledgements

NATIONAL HIGH MAGNETIC FIELD LABORATORY

Funding NSF-DMR #1905757

The Strouse Group

Synthesis Assembly Spectroscopy

Dept. of Chemistry and Biochemistry at Florida State University

References

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4. Nordmann, A., Own Illustration, 2007