Fabrication of Zif-8 Nanoparticles For Biomedical Applications via Machine Learning

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Objective

Study the effects of synthesis parameters on ZIF-8 nanoparticles in order to build analysis and prediction models. Compare drug loading rates of loading during and after synthesis.

Background

- ZIF-8 (Zeolithic Imidazolate Framework-8) is one of the most stable, three dimensional (3D) nanomaterials suitable for various applications.
- Due to its unique characteristics such as high biocompatibility and tunable nanostructures ZIF-8 has great potentials for drug delivery.
- Other materials on the market are have low distribution and solubility. However, ZIF-8 is ideally suited due to its high surface area to volume ratio

Methodology- Overview

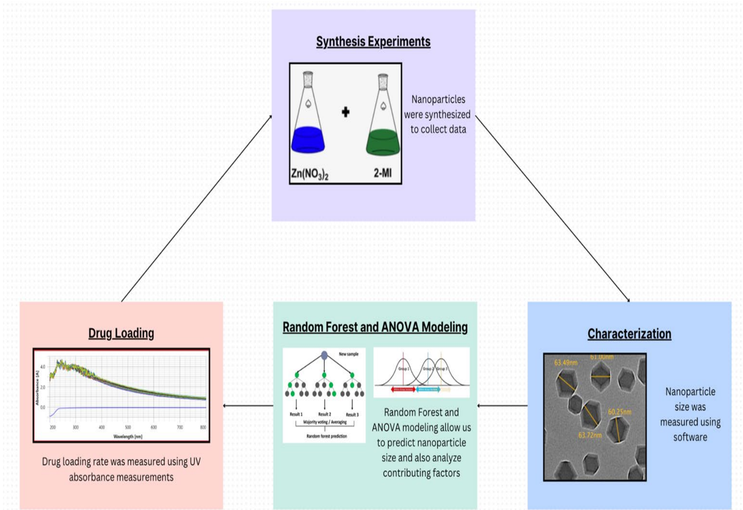

Figure 1: Flowchart of project

Results

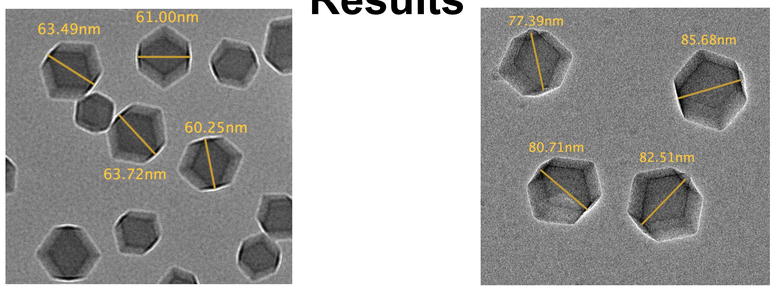

Figure 2: TEM image of ZIF-8 synthesis before (left) and after loading 0.5mg/ml Aspirin (right)

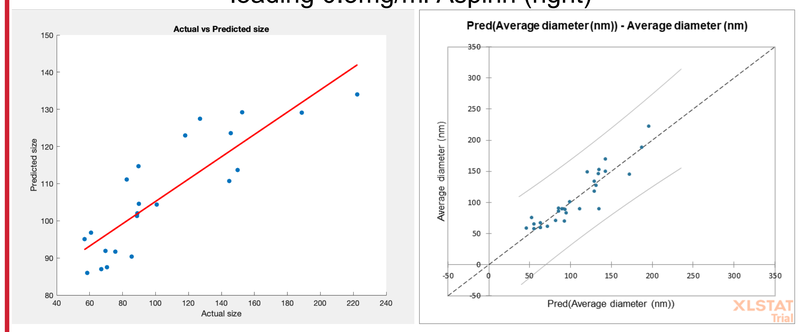

Figure 3: Models of Actual vs Predicted sizes of ZIF-8 synthesis with trend line. R^2 value 0.52 (left). R^2 value 0.849 (right) and P values 0.002 and 0.025 (molar ratio and viscosity respectively)

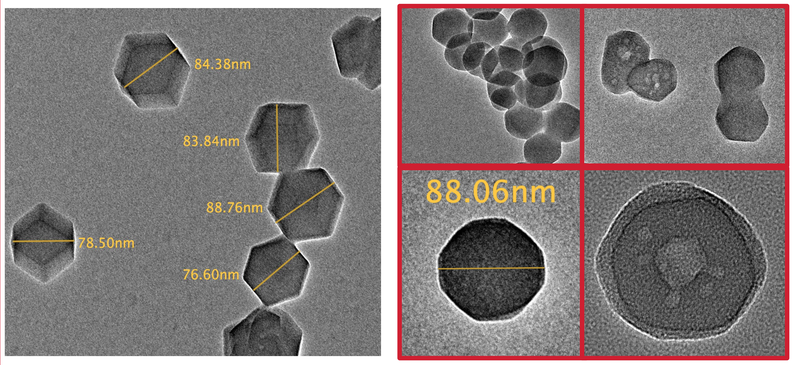

Figure 4: TEM image of ZIF-8 loaded Aspirin during (left) vs after synthesis (after) (top left shows clustering of nanoparticles, top right shows nanoparticles with and without Aspirin, bottom left shows size, and bottom right shows close up of nanoparticle with Aspirin loaded

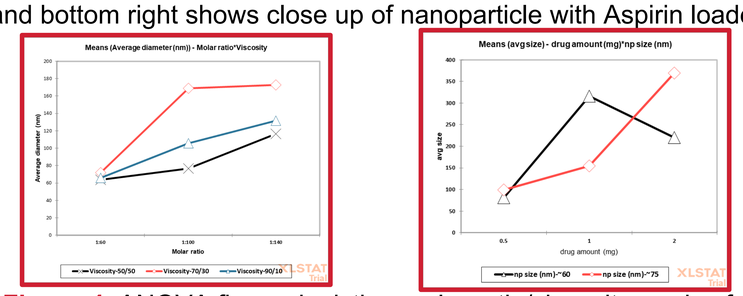

Figure 4: ANOVA figure depicting molar ratio/viscosity vs size for synthesis (left) and drug loading (right)

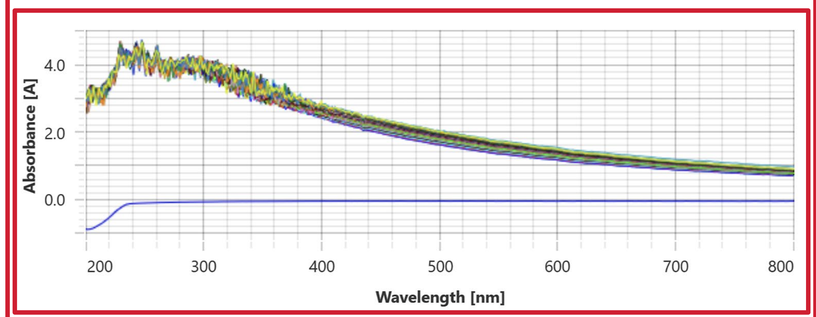

Figure 5: Absorbance vs Wavelength of ZIF-8 loaded Aspirin, used for determining drug loading rate

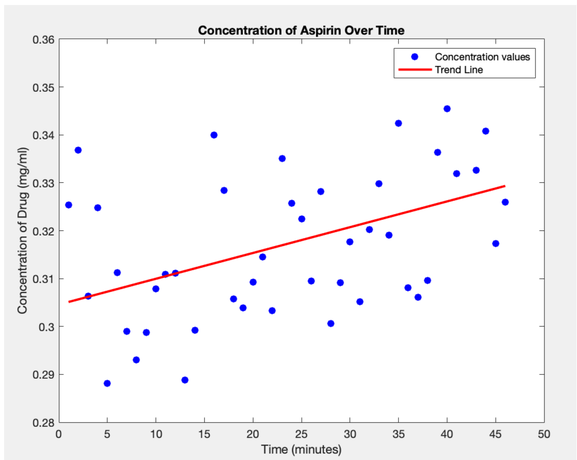

Figure 6: Drug loading rate over time of Aspirin added after synthesis

Conclusion

- ZIF-8 NPs were successfully synthesized and varied in size based on synthesis parameters.
- RFM model was able to successfully predict NP size for given synthesis parameters.
- The ANOVA model was able to give us insight into the significance each parameter had on NP size.
- Drug loading time did not have a significant effect on NP size, and rate was determined using Beer-Lambert Law.

Acknowledgements

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