

Effects of Surfactants on The Yield and Size of Gold Nanorods

K.C. Lee, Ranganathan Gopalakrishnan, Department of Mechanical Engineering
Mentor: Professor Peter H. McMurry, Department of Mechanical Engineering

Methods:

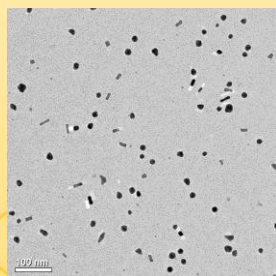
1. Preparation of Stock Solution: The 0.1M CTAB solution was prepared by diluting 3.645g of CTAB in 100mL of DI water. To catalyze the process, the CTAB solution was heated gently while being stirred. The 0.01M Au solution was prepared by diluting 0.03940g of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ in 10mL of DI water. Finally, the 0.01M NaBH_4 solution was prepared by diluting 0.03780g of NaBH_4 in 10 mL of cold DI water.

In 2 of the experiments, the surfactant (CTAB) was substituted with dodecyltrimethylammonium bromide (DTAB) and myristylmethylammonium bromide (MTAB). The 0.1M DTAB solution was prepared by diluting 3.084g of DTAB in 100ml of DI water. The 0.1M MTAB solution was prepared by diluting 3.364g of MTAB in 100ml of DI water. It was observed that with a little stirring, both DTAB and MTAB did not require any heating to dissolve in the solution.

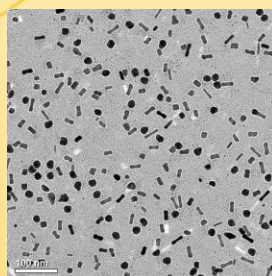
2. Preparation of Au Seed: In a typical procedure, 0.250 mL of an aqueous 0.01M solution of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ is added to 9.75mL of a 0.10M solution of 9.75 mL CTAB solution. This is followed quickly by the addition of 0.600mL of 0.01M NaBH_4 to the solution. The seed mixture is then set aside for 2.5 hours.

3. Experiment proper: Before preparing the growth solution, a solution of AA was made. The 0.1M AA solution was prepared by diluting 0.176g of AA granules in 10mL of DI water. After a clear solution had formed, the following reactants were added in order to 9.5mL of CTAB solution: 0.250mL of, 0.055mL of AA, 50mL of and finally, 0.012mL of the seed solution. In each experiment, the effects of the various reactants and their concentrations were examined by varying their concentrations. This method outlines the set-up for a control solution. The effects of DTAB and MTAB were investigated by substituting the CTAB with the respective surfactants.

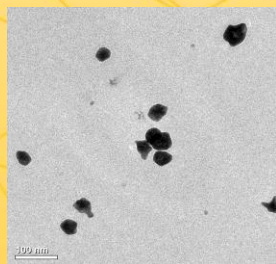
4. After 24 hours, the growth solutions are examined under a transmission electron microscope and the results are analyzed using ImageJ.



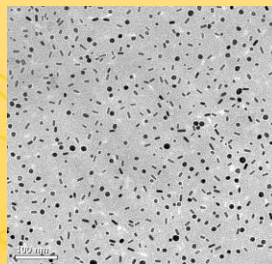
DTAB 12µL seed concentration



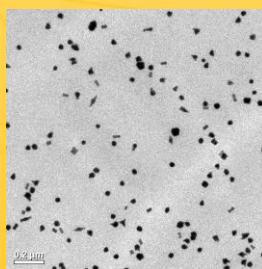
DTAB 100µL seed concentration



MTAB 12µL seed concentration



MTAB 100µL seed concentration



MTAB 24µL seed concentration

Results:

DTAB

	12µL seed concentration	100µL seed concentration
mean length (µm)	23.67449	25.72375
length coefficient of variation	0.171791	0.201312
mean width (µm)	9.656231	10.01134
width coefficient of variation	0.119142	0.190359

MTAB

	24µL seed concentration	100µL seed concentration
mean length (µm)	13.33646	14.30317
length coefficient of variation	1.615643	0.162171
mean width (µm)	6.54475	6.419139
width coefficient of variation	1.600566	0.151861

From the results, for both MTAB and DTAB, varying the seed concentration did not vary the aspect ratio of the rods significantly. This can be inferred from the similar aspect ratios that were obtained. However, the number of non-rod particles increased as the seed concentration was increased. For the MTAB samples, no rods were present at all for analysis in the 12µL sample.

References:

Sau T.K.; Murphy C. J. *Langmuir* **2004**, 20, 6414-6420

