Characterizing the pH dependence of surface charge for silica nanoparticles made by amino acid synthesis

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Introduction

- Nanoparticle research has made advances in many modern applications, such as cancer therapy and diagnosis, drug and DNA delivery systems, ultrasensitive analysis, and nanoparticle films as antireflective and antifogging coatings.
- Amino acid synthesis is advantageous because it is harmless under biological conditions.
- Applications depend on order in packing of nanoparticles, which depends on particle charge and pH of solvent.

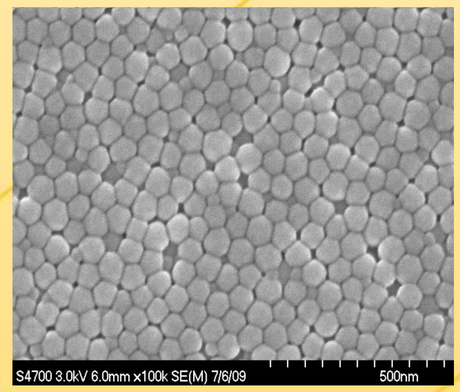
Methods

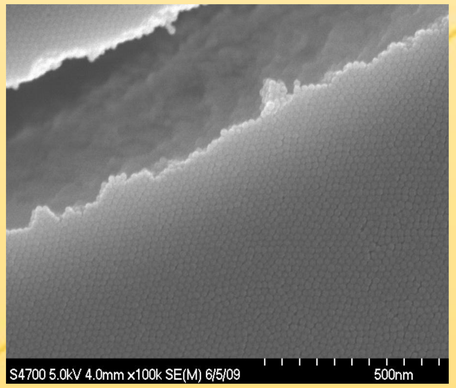
Silica nanoparticles were synthesized via the Lys-Sil method:

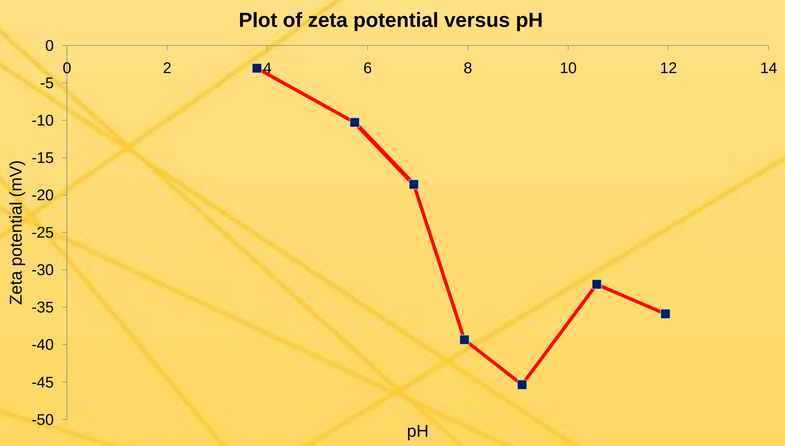
- Tetraethylorthosilicate (TEOS) was hydrolyzed in the presence of L-lysine.
- The solution was hydrothermally aged for 48 hours and ethanol was removed under reduced pressure.
- pH of the solution was altered by addition of various concentrations of hydrochloric acid or sodium hydroxide.

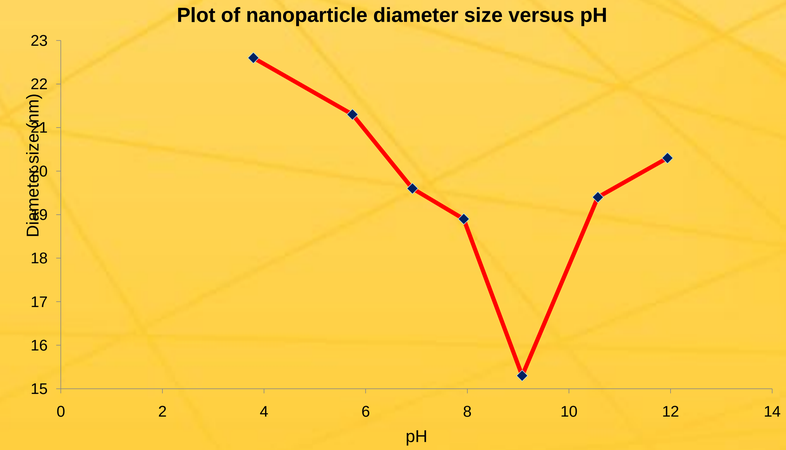
Characterization included light scattering tests for particle size and zeta potential analysis for surface charge:

- Electric field is applied via electrophoresis, causing charges to migrates towards either the positive end or negative end based on surface charge.
- Migration velocity is proportional to magnitude of charge.
- The analyses are carried out by ZetaPlus software.









Results

- Lys-Sil synthesis gives silica nanoparticles of consistent size.
- Nanoparticles were synthesized around pH 9.
- Increases and decreases in pH resulted in larger nanoparticle diameter size.
- Lowering pH decreased nanoparticle surface charge.

Discussion

- Interaction between amino groups on L-lysine interacts with silicates (SiO^-) to affect nanoparticle size.
- Amino groups affected by pH of solution.
- Lower pH may cause silicates to be protonated.

References

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