Nanoparticle-Neural Stem Cells for Targeted Ovarian Cancer Treatment:

Optimization of the Stability of Silica Nanoparticles for Drug Loading

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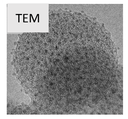
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BACKGROUND

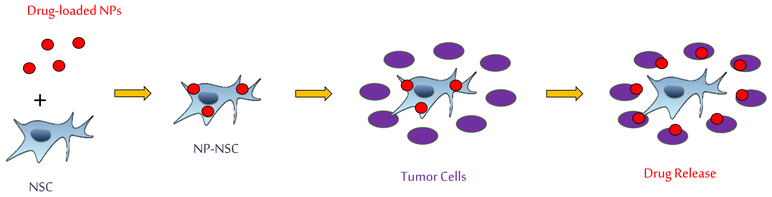
- Cisplatin is a drug that treats ovarian cancer
  - Kills healthy tissue in addition to cancer cells
- Neural stem cells (NSCs) migrate directly to ovarian tumors
- If free cisplatin is loaded into NSCs for targeted drug delivery, it will kill the NSCs
- Silica nanoparticles (SiNPs) act as a protective carrier to prevent the drug cisplatin from killing both the NSCs and normal surrounding tissue



SiNP [Pt]

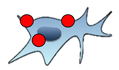


BIG PICTURE



GOAL

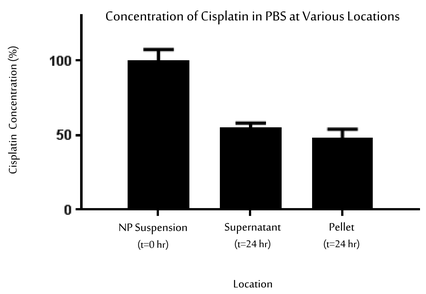
- Maximize drug delivery using NSCs
- Minimize toxicity to NSCs using SiNPs

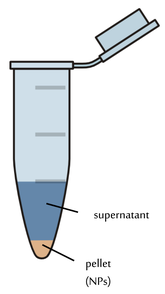


NP-NSC

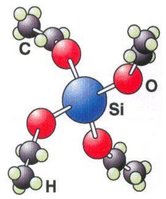
PROBLEM

When the SiNPs [Pt] were tested in PBS (phosphate buffered saline), the cisplatin leaked out of the particles prior to NSC loading.





INTRODUCTION



Tetraethyl Orthosilicate (TEOS)

Optimization of the SiNP stability will result in particles that are stable and do not leak the drug.

- Tetraethyl Orthosilicate (TEOS) is one of the main components of SiNPs
- TEOS contributes the carbon in SiNPs

HYPOTHESIS

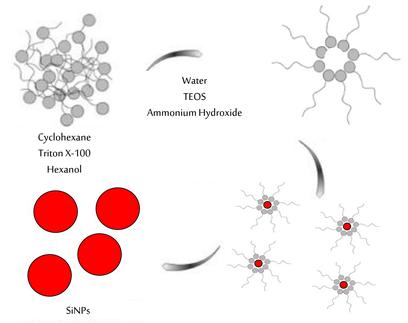
The more TEOS added to the solution when making SiNPs will result in more stable the SiNPs. This is because there will be more carbon in the chemical structure of the SiNPs, and thus it would be harder for cisplatin to leak out of a tightly-packed particle.

PROCEDURE

- Synthesize the SiNPs by microemulsion method
- Characterize the SiNPs
  - Transmission Electron Microscope (TEM)
- Check Stability of the SiNPs
  - Cell Media
  - PBS

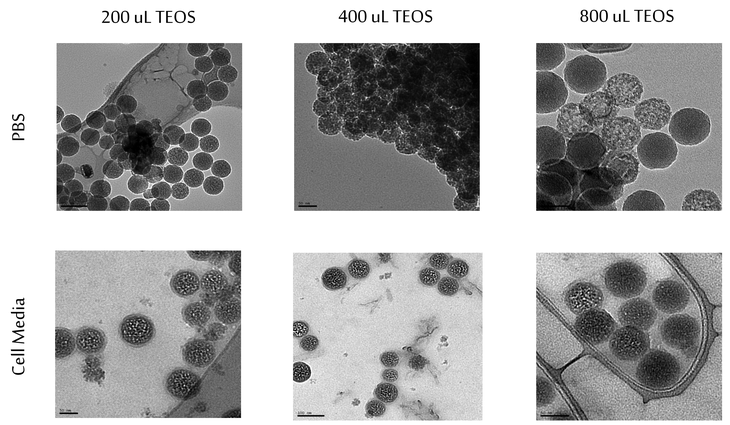
SYNTHESIS OF SiNPs

Microemulsion Method:

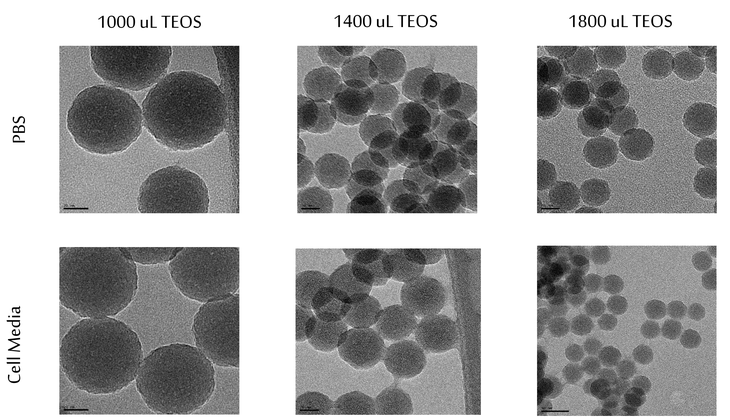


RESULTS

TEM IMAGES OF UNSTABLE SiNPs

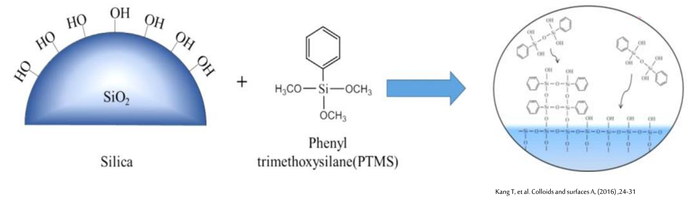


TEM IMAGES OF STABLE SiNPs



DISCUSSION

To verify that the stability of the SiNPs is based off of the TEOS concentration, we added another organic substance phenyl trimethoxysilane (PTMS) to the unstable, porous particles. By adding more PTMS, we believe that the particles will be more stable as there will be more carbon in the chemical structure. We used the thermogravimetric analysis (TGA) machine to quantify the organic substance in SiNPs.



Kang T, et al. Colloids and surfaces A. (2016) ,24-31

Thermogravimetric Analysis (TGA)

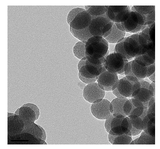
	400 uL TEOS	1800 uL TEOS
Organic contents (weight loss)	11.56 %	30%

Using the TGA, we noticed that the 1800 uL TEOS batch had more organic matter than did the 400 uL TEOS batch.

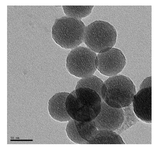
	400 uL TEOS	400 uL TEOS + PTMS
Organic contents (weight loss)	11.56 %	**49.66 %**

When PTMS was added to the 400 uL TEOS batch, there was a significant increase in organic matter.

TEM IMAGES OF 400 uL TEOS + PTMS



Water



PBS

As shown in the TEM images, adding PTMS did significantly increase the stability of the 400 uL TEOS SiNPs. They are stable in both water and PBS.

CONCLUSION

The ultimate factor that determines the stability of our microemulsion-synthesized SiNPs (100 nm) in PBS and cell media is the concentration of TEOS. Confirming our hypothesis, the more TEOS added, the more stable the SiNPs will be.

We can also conclude that cisplatin had no effect on the stability of the SiNPs as we have the same results from the SiNP [Pt] and empty SiNPs.

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