Nanotechnologies

Poly(d,l-lactide-co-glycolide)-polyethyleneimine/ reduced nanographene oxide nanoparticles for chemo-phototherapy of cancer

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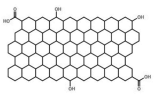
Background

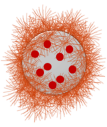
- Cancer illness such as triple-negative breast cancer lacks specific treatment targets which leads to poor treatment outcomes.[1]
- Photothermal therapy can synergistically work with chemotherapy.[2]
- Mild temperatures increase (39-45 °C) are able to induce cancer cell death and trigger drug release.[3]
- Graphene-based nanomaterials possess high near infrared absorption being ideal photothermal agents.[4]

Reduced Graphene oxide



✓ Higher NIR absorption
✓ Biocompatible

PLGA-PEI Nanoparticles (NP)



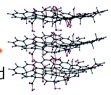
✓ High Loading capacity
✓ Enables surface moieties
✓ Biocompatible

- The copolymer of lactic glycolic acid (PLGA) is FDA approved, and allows high encapsulation yields for multiple drugs, such as the new one studied in this work - anticancer drug 1 (ACD-1).[5]
- Surface modification with polyethyleneimine (PEI) allows higher internalization and therapeutic effect.[5]

Reduced Graphene Production

Graphite powder

Modified Hummers Method

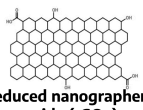


Graphite oxide

Size reduction ultrasonication

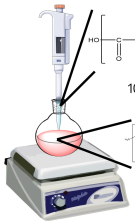
Graphene oxide

Light induced Photoreduction

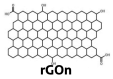


Reduced nanographene oxide (rGOn)

Nanoparticle formulation



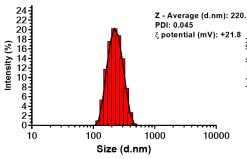
PLGA 10 mg/mL



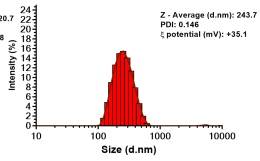
rGOn 1 mg/mL

PEI 0.5 % m/V

PVA (stabilizer) 0.5 % m/V

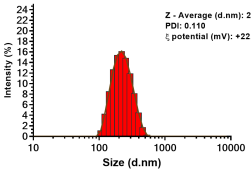


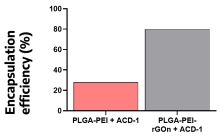
PLGA-PEI NP



PLGA-PEI-rGOn NP

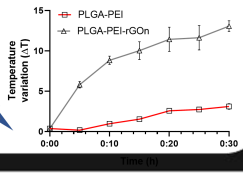
Drug encapsulation





PLGA-PEI-rGOn + ACD-1 NP

Encapsulation of ACD-1



NIR irradiation

Conclusions

- PLGA-PEI-rGOn particles were successfully produced, presenting sizes around 200 nm and being water stable.
- It was possible to encapsulate ACD-1 into those particles and rGOn presence increased encapsulation efficiency by around 3.8-fold.
- rGOn incorporation led to temperature increases above 13 °C, allowing to achieve values which permit their use for both triggered drug release and combined photothermal therapy.

References

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