Targeted Cancer Detection Using Folic Acid Functionalized Graphene Quantum Dots

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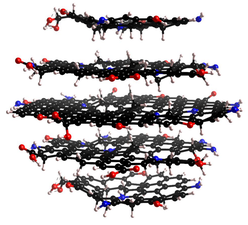
Abstract

Among the most life-threatening diseases, cancer poses a major issue and affects over fifty million people worldwide. To overcome the challenges associated with conventional chemotherapy, affecting both cancerous and normal cells, here we develop folic acid-functionalized Graphene Quantum Dots (GQDs) targeted to folate receptors overexpressed in a variety of cancer cell lines. GQDs due to their high biocompatibility and intrinsic fluorescence-based imaging capabilities have recently emerged as promising theragnostic agents. In this project, we synthesized GQDs utilizing the bottom up synthesis method and functionalized them with folic acid. The efficacy of the Folic acid functionalized GQDs (FAGQDs) is evaluated through their internalization study in cancerous (HeLa) and normal (HEK-293) cells by utilizing the intrinsic fluorescence of FAGQDs.

Introduction

Graphene Quantum Dots (GQDs)

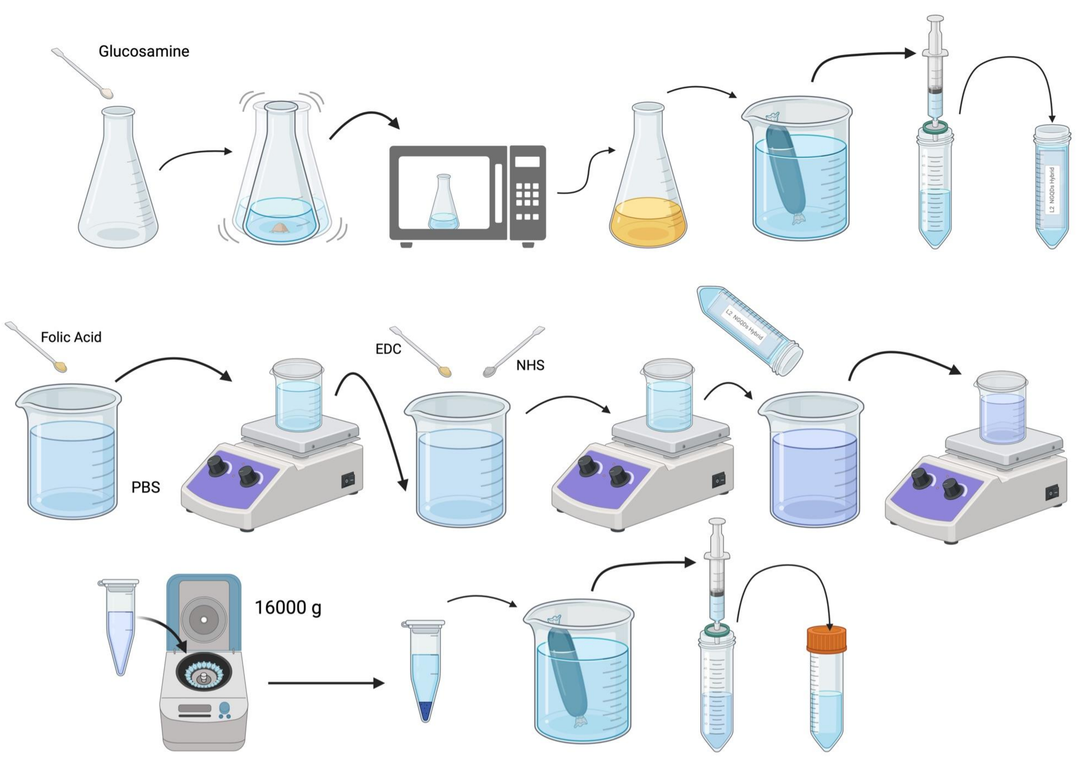
- Biodegradable
- Biocompatible
- Photostable
- Fluorescent in NIR:
  - Drug delivery
  - Guided Surgery
  - Cell imaging



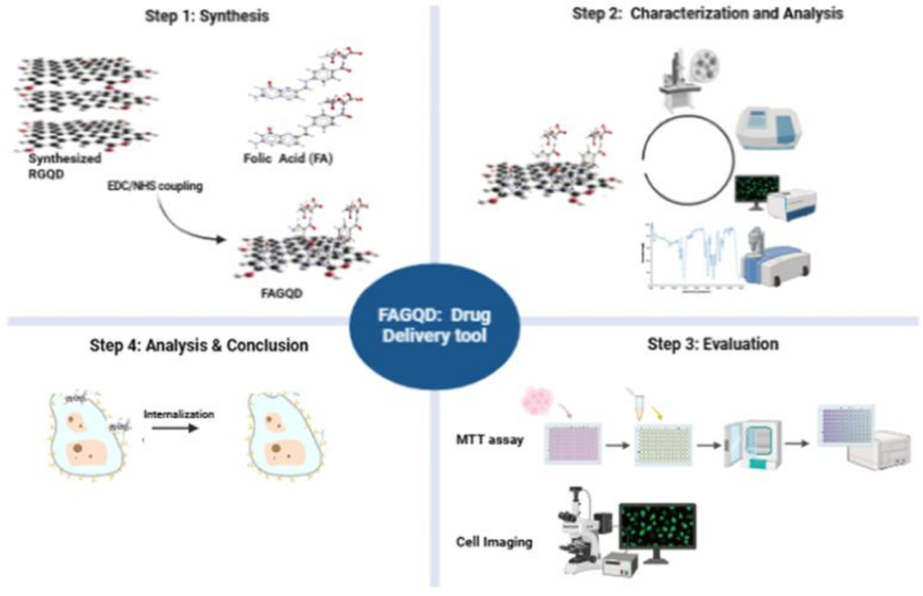
Folic Acid Functionalized GQDs for Cancer Detection

- Cancer cells overexpress folate receptors
- Folic acid binds to folate receptors
- Near-infrared (NIR) wavelengths provide a non-invasive imaging method
- GQDs exhibit fluorescence in NIR
- Folic acid functionalized GQDs may preferentially bind to cancer cells allowing for cancer detection through NIR fluorescence

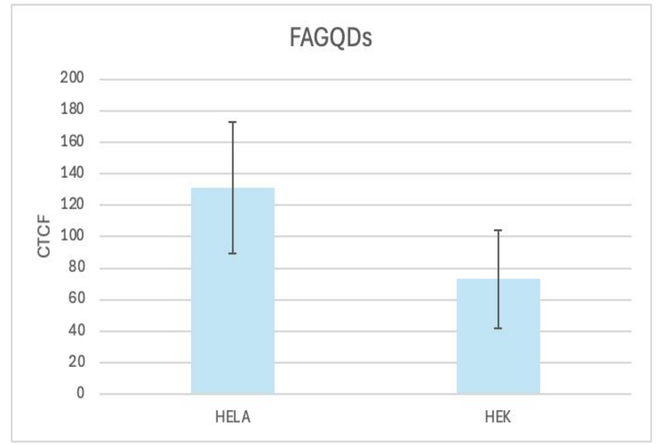
Synthesis Method



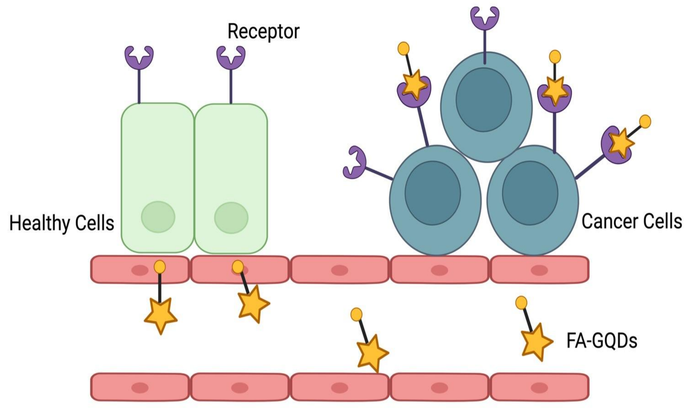
Steps



Results



FAGQDs Binding to Receptors



Conclusion & Future Work

- Folic acid functionalized GQDs show promising results
- Functionalize folic acid with GQDs synthesized using top-down method
- Utilize FAGQDs for drug delivery

Cancer treatment often affects healthy and cancerous cells alike. To solve this, we created glowing carbon nanoparticles called graphene quantum dots, or GQDs, that are combined with folic acid. Since many cancer cells have high levels of folate receptors, these folic acid-conjugated GQDs (FAGQDs) act like guided missiles, delivering drugs or imaging agents directly to tumors. In our study, FAGQDs safely entered cancer cells more effectively than normal ones, with minimal toxicity. Thanks to their built-in fluorescence, we will also track their movement inside cells. This dual-purpose nanomaterial offers a safer, smarter approach to both diagnosing and treating cancer.